CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

Federal Construction Financing Tops 8.5 Billions

DURING 1941 requests totaling $8,711,311,000 were made for government funds to carry on defense and regular departmental construction. All but 11 percent of this volume has been appropriated.

Funds for defense construction naturally play the major part, $7,587,000,000 having been asked for that program—$6,642,000,000 already appropriated, and $945,000,000 in the process of legislation. This defense volume includes money for construction in the outlying possessions as well as for continental United States.

Four important programs within the defense set-up received over one billion dollars during the year. They are the army camp and cantonment program, $1,078,923,000; war and ordnance plant construction, $1,610,980,000; Army and Naval airbase and airport work, $1,165,445,000; and shipbuilding and repair facilities, $1,232,500,000.

FEDERAL FUNDS APPROPRIATED OR IN PROCESS OF LEGISLATION FOR DEFENSE CONSTRUCTION IN 1941

ARMY CAMPS AND CANTONMENTS

Completion of cantonment program	$575,000,000
Storage facilities	67,923,000
Additional storage facilities	112,000,000
Roads, walks, parking areas, etc.	40,000,000
Army military posts	84,000,000
Air corps barracks	200,000,000
	$1,078,923,000

NAVAL BASE CONSTRUCTION (NOT AIR)

Shore establishments	$100,503,000
Shore establishments and storage	294,529,000
Shore establishments	335,000,000
	$730,032,000

ORDNANCE PLANTS

(Includes tools and equipment as well as plants)

Doubling naval ordnance plant facilities	$194,000,000
Tin smelter, etc.	12,250,000
Rolling mill	12,000,000
Lend-Lease plants (est. for plant only)	376,000,000
Munitions plants, War Dept.	549,000,000
Naval ordnance facilities (additional)	125,000,000
Steel plant expansion (D.P.C.)	154,730,000
Plants, 3rd Supplemental Def. Appr. Act	188,000,000
	$1,610,980,000

ARMY AND NAVAL AIRBASES AND AIRPORTS

Atlantic Airbases, Navy	$78,445,000
Army Airbases	70,000,000
Atlantic Airbases, Army	94,000,000
Atlantic Airbases, Army	51,000,000
Army air fields	45,000,000
Navy Air Stations	100,000,000*
Army air fields	600,000,000
C.A.A. Airports	127,000,000
	$1,165,445,000

PUBLIC WORKS IN DEFENSE AREAS

Local public works	$300,000,000
	$300,000,000

SHIPYARDS AND SHIPWAYS

Expansion of private ways	$315,000,000
Lend-Lease program ways	22,500,000
Naval shipyards, etc., and repair facilities	845,000,000*
Maritime Commission	50,000,000
	$1,232,500,000

DEFENSE HOUSING

Defense housing	$150,000,000
Defense housing	75,000,000
Defense housing	300,000,000
Defense housing	300,000,000
	$825,000,000

MISCELLANEOUS DEFENSE CONSTRUCTION FUNDS

Rivers and harbors for defense	$55,426,000
Panama Canal	149,320,000
Access Roads, military highways, repairs to existing roads	130,000,000
Office buildings	25,000,000
	$359,746,000

OTHER BILLS (NOT ENTIRELY DEFENSE)

WPA Deficiency Bill, $375,000,000 (Contains estimated 25 percent for defense construction, Municipal airports, etc.)	$93,750,000
WPA Funds for 1942, $910,905,000. (Portion to aid CAA program, military road construction, etc.)	330,203,000
Interior Department (Bureau of Reclamation, etc.)	115,085,000
Commerce Department (Civil Aeronautics Admin.)	94,978,000
Other construction	2,169,000
TVA—Dams for increased power, etc. for defense manufacturing	159,000,000
War Department—Civil	122,000,000
Independent Offices	216,000,000
Department of Agriculture	109,000,000
Federal-Aid Highways	135,000,000
Dam Construction	35,500,000

*Denotes bill in process of legislation.

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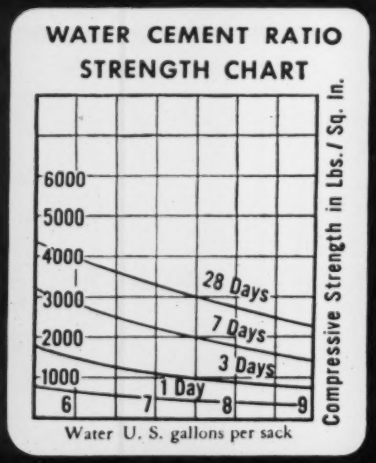

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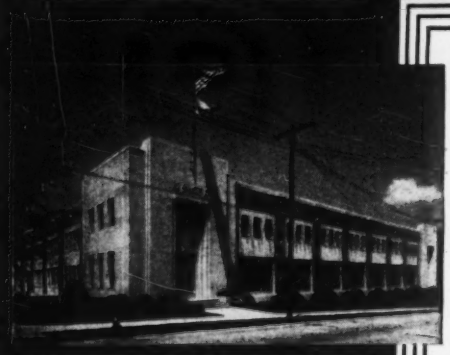

COCA COLA BOTTLING COMPANY, ATLANTA, GA. George H. Bond, Atlanta, Architect. Griffin Construction Company, Atlanta, General Contractors. Six tons Truscon Waterproofing Paste Used in This Construction.

SOUTHEASTERN GREYHOUND BUS TERMINAL, ATLANTA, GA. James C. Wise, Architect. Hardin & Ramsey, Inc., General Contractors. Truscon Waterproofing Paste used here.

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Vol. 128 JANUARY 15, 1942 No. 3

THIS WEEK

• The record-breaking accomplishments of the construction industry during 1941 provide the theme of this "Annual Review Number." This appraisal of the last year provides a background for indicating the trends of both engineering thinking and construction practice for 1942.

• Following the editorial pages, which present a summary of 1941 activity and advances, a group of statements by members of the editorial staff outlines the special fields of activity and principal items of progress. Another of the regular features for this issue is the review of "Headline Projects," indicating the present status on major construction jobs which were active during the last year.

• Because 1942 will present special problems of engineering interest, a group of four articles, by authorities in their respective fields, will review the subjects which result directly from the war and its impact on civil engineering.

THINGS TO COME

• Having described the design of the cofferdam at TVA's Kentucky Dam in the issue of January 1, an article in the next issue will review construction procedure on the job.

• The processing of several million yards of earth fill at Green Mountain Dam involved a unique contractor's plant, which will be described.

• Flood control at Hartford, Conn., has called for the building of a reinforced concrete conduit of record size, which will be described under the heading of "Putting A River Underground".

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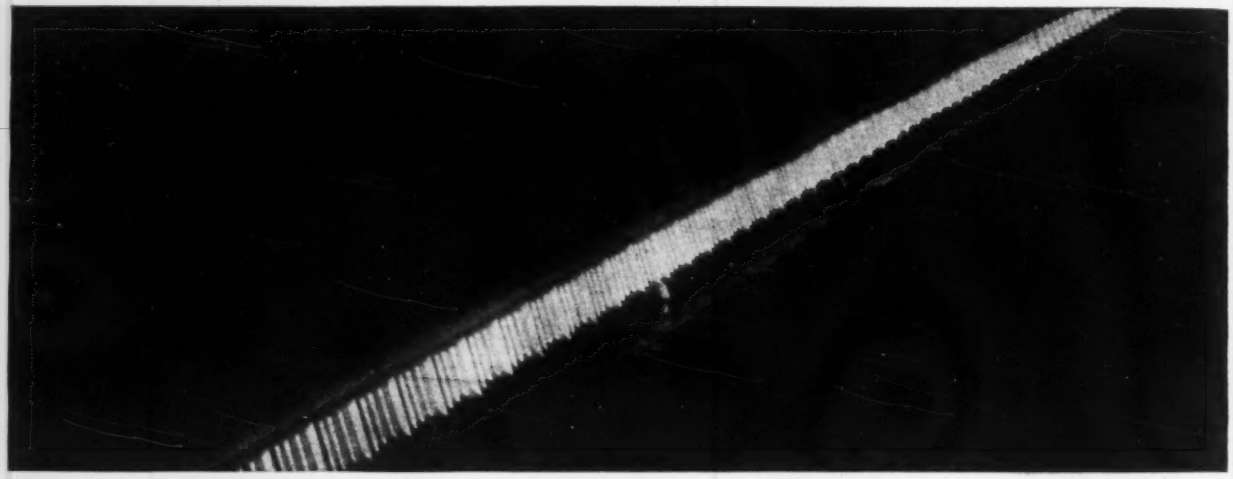
THEY TURNED CONCRETE INTO MIRRORS

that make night driving SAFER!



WHY IS the visibility of smooth concrete curb practically nil under car headlights? And why does White Concrete Reflecting Curb, even on rainy nights, as in this picture, provide a gleaming guide to safety?

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ENR-M-27

WHITE CONCRETE REFLECTING CURB

MADE WITH ATLAS WHITE CEMENT

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JANUARY 15, 1942 • VOLUME 128 • NUMBER 3

Prefabricated house program pushed into mass production

Federal Works Agency calling for an initial order of 42,000 demountable houses will award contracts on negotiated lump-sum basis.

The Federal Works Agency last week made a fast start on a $153,000,000 program to build 42,000 prefabricated houses in about fifty locations. This is part of a $300,000,000 program of temporary housing approved by the President a couple of weeks ago (*ENR*, Dec. 25, 1941, p. 903). Housing Coordinator Palmer has allocated a little over half this sum to FWA and another $13,000,000 for 5,667 trailers and 5,200 dormitory units for single workers. Remainder of the money is being held for allocation to emergency needs as they arise and probably will be distributed over the next couple of months. It is expected that the houses will be ready for occupation by July.

To carry out this program, FWA's new administrator, Gen. Philip B. Fleming, wiped out the Division of Defense Housing which has been handling the 9,000 or so prefabricated houses included in previous programs. Execution of the new program has been put directly under the administrator and has been made the responsibility of Rufe B. Newman, former head of the construction section of the Division of Defense Housing. Newman will form what amounts to a special prefabrication agency, drawing his staff from the personnel of the various FWA divisions.

Monthly production 15,000

To carry out the present job, and to meet additional demands for temporary housing that will be coming along soon, a manufacturing capacity of about 15,000 prefabricated houses a month is desired. Capacity of present prefabricators plus a considerable number of wood-working shops that can be converted to house-manufacturing is believed to be about 10,000 houses a month.

An additional 5 to 6,000 a month can be obtained with field-prefabrication operations, involving the establishment of a woodworking shop right alongside the job. The choice at any particular site is a matter of balancing the greater efficiency of larger scale operations against transportation cost.

A great deal of conversion of wood-working shops is involved in the new program. Two procedures are available. The newcomer to the field—a mill-working shop or the like—may design its own house, following floor plans and standards which have been adopted by FWA (available in a brochure issued by FWA Jan. 1) and seek approval of it from Newman's group.

Alternatively, the shop may arrange to use the designs of a prefabricator whose product has already been approved by FWA. Most of the prefabricators are now scouring the country looking for additional capacity to meet the overwhelming increase in demand. In such cases, FWA will contract for houses jointly with the proprietor of the design and the shop doing the actual work. No sub-contracting arrangements will be used.

FWA policy favors having the house manufacturer do the actual erection at the site in order to have central responsibility. It is recognized, however, that most manufacturers lack an erection staff adequate for a program of this size, and FWA is prepared to make separate erection contracts. In all such cases the manufacturer will be required to have representatives at the site to supervise the erection. The house manufacturer will be given the opportunity to suggest a particular contractor to erect his houses. Failing that, FWA will pick one.

How to get a job

There will be no competitive bidding in the temporary housing program. All contracts will be on a negotiated lump-sum basis. Contractors who want erection or site-preparation jobs or manufacturers who want to furnish houses should present their qualifications to Newman (Dupont Circle Building, Washington) in order to get consideration. No set form of application has been adopted. In fact Newman is basing his selection of contractors in part on their skill in presenting their case.

A program of this nature involves a minimum of engineering. Newman's group will design no houses, will simply pass on manufacturers' designs presented for approval. For the engineering work in connection with site preparation local firms will be retained. For the present, arrangements with such firms are being made through the Washington office. Engineers wanting work on this program should follow the same procedure as recommended above for contractors.

The temporary nature of this demountable housing program considerably simplifies the problem of site selection. The considerations of city planning and coordination with the future growth of the community which have made choice of

To direct defense housing

Rufe B. Newman, Jr.

Rufe B. Newman, Jr., a civil engineer and formerly chief of the construction section of the division of defense housing of the Federal Works Agency, has been placed in charge of construction for the government's prefabricated defense housing program. He comes to the job with a wealth of experience gained in other branches of the construction industry, including the direction of over $300,000,000 in PWA projects. He was assistant director of PWA in Tennessee in 1935, and prior to this position served as chief engineer.

site a ticklish job to date will be disregarded. Major considerations will be to get within walking distance of the plant being served and, where possible, to find sites already served by utilities. Abandoned subdivisions are expected to meet this requirement in many places.

In many cases it will not be possible to meet these site requirements and still concentrate a project in one big area. Each housing project is likely to be spread around in comparatively small groups. A secondary motive for this policy is the recognition that to assemble in one place most of the workers in a vital munitions plant is nothing but an invitation to enemy action.

Twenty-one locations for prefabricated housing projects have already been announced, and about thirty more are awaiting the formality of Presidential approval. Of those announced, the largest are at Mobile, Ala., 1,060, Buffalo, 1,050, and Dayton, 750 houses.

• • •

Sixty-three million bid on third Gatun lock

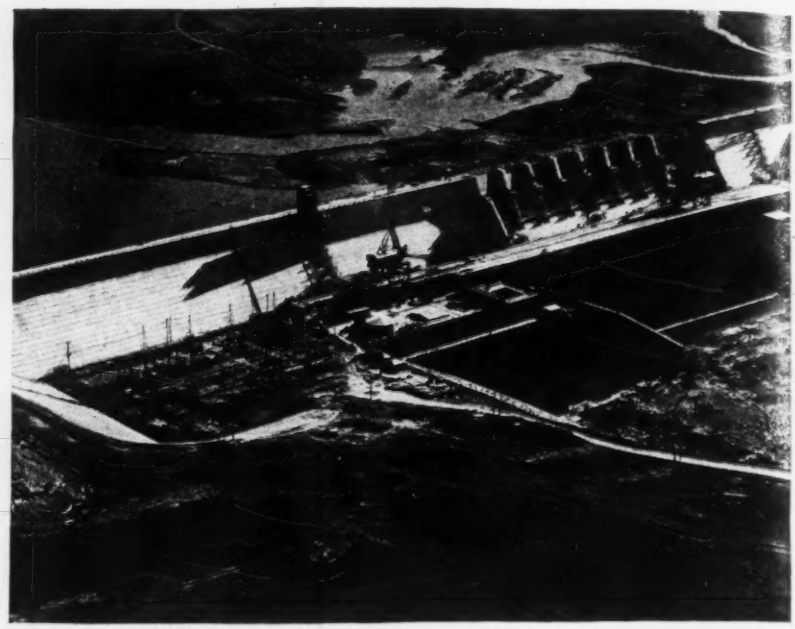
The Panama Canal last week received only one bid, which met all the conditions, for construction of the new Gatun Locks—part of the program to supply a third set of locks for the canal. This bid, $63,223,458, was submitted by a syndicate, Pan-Materials Construction Co. with offices at Balboa. A considerably lower bid, $46,250,000, was submitted by Samuel R. Rosoff, Ltd., of New York. Rosoff, however, submitted no bond with his bid. Another group, American Contractors, Inc., with offices at Oakland, Calif., submitted no bid but offered to negotiate a price on the job.

The work on the Gatun lock includes furnishing most of the steel, but the gates and other machinery as well as the cement and aggregates will be furnished by the government under separate contracts. Most of the excavation is also being handled under a contract held by Wunderlich and Okes.

The Pan-Materials bid specified that the government must bear the risk of any losses resulting from enemy action.

Members of the Pan-Materials group are: W. E. Callahan and Gunther & Shirley, Brown & Root, Martin Wunderlich (who already shares in the excavation work), McKenzie Construction Co., Peter Kiewit Sons, George W. Condon.

Membership of American Contractors, Inc., includes W. A. Bechtel, S. A. Healey, Kaiser Co., and Henry J. Kaiser. Kaiser is said to have the controlling interest in this group. Healey is president and Kaiser is a member of the Panama Constructors group which already holds a $22,000,000 dredging contract at the Pacific end of the canal. The government will explore what this group offers.



TVA dams dedicated over a nation-wide radio hook-up

Cherokee and Watts Bar Dams, major projects in the Tennessee Valley Authority's emergency hydro-electric program to develop additional power in the Southeast, were officially dedicated by Attorney General Francis Biddle, over a nation-wide "Power for Victory" radio broadcast from Washington last week.

Cherokee Dam on the Holston River above Knoxville, Tenn., was closed on Dec. 7, 16 months after its construction was authorized, which according to TVA set a new world record in large scale dam construction. Ordered built in 20 months, the project was put into construction on Aug. 1, 1940, within 24 hours after its authorization by Congress, and the dam was completed to closure four months ahead of schedule.

The drainage area above the Cherokee site is 3,428 sq.mi. and the structure will have a storage volume of 1,640,000 acre-ft., of which 1,200,000 acre-ft. is controlled. With the closure completed the reservoir can be filled during the coming spring season. An initial installation of three generators with 90,000 kw. capacity will be made.

Watts Bar Dam on the Tennessee River about 50 miles northeast of Chattanooga, Tenn., will start producing power at the end of this month, a year ahead of schedule.

Cherokee and Watts Bar Dams were authorized by Congress as national defense projects to produce power urgently needed by aluminum plants and other important defense industry in the Tennessee Valley. The two plants will increase installed power capacity of the TVA system by about one-quarter million kilowatts.

Boston to demolish its Atlantic Avenue "L"

The Boston Elevated Railway's Atlantic Avenue line, which ceased operation Oct. 1, 1938 after over 39 years of service, has been ordered razed, and bids will shortly be requested by the trustees of the road. The decision was handed down by the Massachusetts Supreme Court Jan. 9, which declared the property to have voided the company's right to maintain it, since the structure is no longer used for the purposes named in the franchise. The 1939 legislature passed a law declaring the franchise forfeited and authorizing the city to raze the structure, a double-track elevated line running along the waterfront and forming a loop around the main rapid transit route through the Washington Street tunnel. Inadequate patronage of the line led to its abandonment in 1938.

It is estimated that demolition will cost $200,000 and that the salvage of materials will total $135,000. The company's assets will be lowered by about $3,000,000 by the removal of the structure and equipment. The estimated quantities involved are 9,041 tons of structural steel of excellent scrap value; 970 tons of rails; 104 tons of malleable iron; 210 tons of miscellaneous steel; 74,000 pounds of copper and 9,000 pounds of miscellaneous metal. The length of structure to be removed is 11,413 ft. The work will require 6 to 9 months. The only obstacle to immediate demolition would be an appeal by the directors of the road to the United States Supreme Court.

Mid-West contractor organizations hear about war construction work

Probable trends of industrial activity, highway work, camps and airports discussed along with priority problems.

Five chapters and branches of the Associated General Contractors of America in the Mid-West held well-attended annual meetings last week. The Illinois Contractors Association turned out in record attendance at Springfield. At Des Moines the strong Central Branch pulled in members from all over blizzard-swept Iowa in an enthusiastic but serious gathering. And two groups of Kansas contractors, the Kansas Contractors Association and the Associated Building Contractors, crossed the state line to meet in Kansas City, Mo., where the Kansas City Chapter (builders) were also in session.

All meetings followed the same general topics—requirements of war construction, fate of private and highway work, and priorities on materials, supplies and equipment. H. E. Foreman, managing director of the A.G.C., and M. W. Watson, president, both spoke at each session. H. K. Bishop, Public Roads Administration, explained the highway situation to the Illinois and Kansas groups, who also heard their own state officials on the subject. Iowa highway department engineers addressed the Des Moines session.

Contractors are ready

In all of his talks Mr. Foreman declared that contractors and the construction industry are ready for whatever the military and public officials may decide. "The contractors want to know how soon we can get going on the all-out effort," he stated. "The construction industry needs no pep talk. We have been in this war for 18 months on the home front and at outlying bases. Construction workers and their bosses are already in the hands of the enemy at more than one point."

He explained that planning in cooperation with the Allies has delayed start of work on the new war construction program, but he also strongly urged that work be started soon for construction labor ranks may be depleted by call to military service and by a shift to war industries. Commenting on the army's procedure at the moment of taking normal lump sum or unit price bids, he remarked that contractors are not kicking, for they have always taken risks, but they want to get to work at the earliest possible moment when every day's delay is costing the lives of American soldiers, and there is no time to take bids now. He also doubts that the proposed engineer-management type of contract will work. Mr. Foreman strongly urged all contractors interested in war construction to qualify with their district and division engineers, U. S. Corps of Engineers, who now direct all army work and can award contracts up to $5,000,000 direct.

Mr. Watson endorsed Foreman's remarks about the readiness of the construction industry. He reviewed the negotiated fee type of contract as successful and probably best under existing conditions, lamenting the unfavorable public impression created by congressional investigations of a few such contracts. Actually, he said, contractors made only slightly more than 1 percent profit on this work. The hazards of bidding normal contracts today would be costly to the government, as high contingencies necessarily would be included. Mr. Watson urged cooperation with the government and local officials in civil defense problems as the best means of public relations possible. Looking ahead, he stated, "I are not ready to admit that the United States has reached its final goal. There always will be construction. Every war has been followed by a construction boom, but don't overlook the trend of socialistic effort in construction. The advocates of WPA and day labor will not rest while we are out building for war."

Highway situation confused

Mr. Bishop, C. M. Hathaway of Illinois, Fred White of Iowa, and Ross Keeling of Kansas, all admitted that the highway situation was confused at the moment until the military authorities express their desires, but stated that the total highway construction for the year would probably reach a substantial volume. All declared that highways must be adjusted to serve the transportation needs of war. They also explained the present priorities situation, and outlined how substitutes are being used in road and bridge construction to take the place of critical materials. Restrictions on tire purchases have already curtailed civilian highway travel to the point where gas tax revenues are decreasing. Further

(*Continued on page* 81)

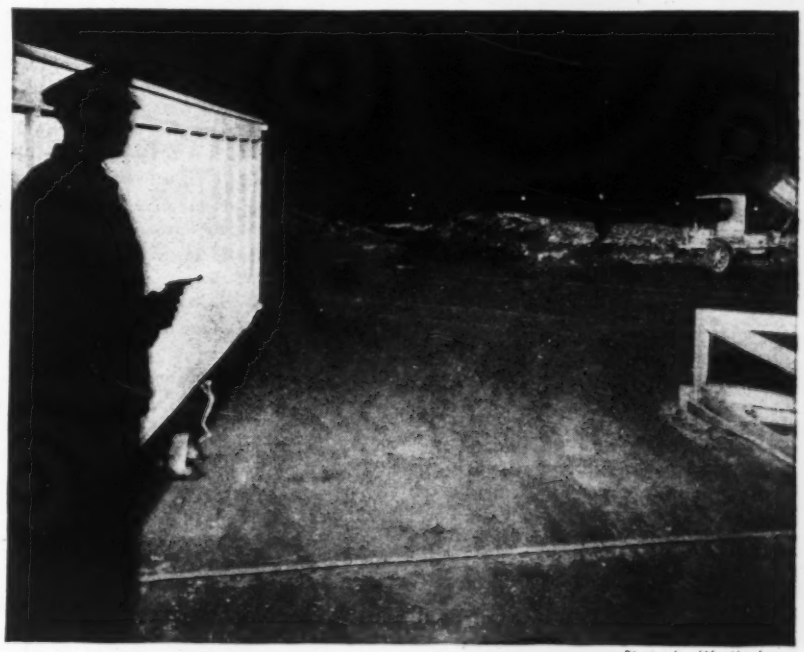


Photo by Westinghouse

Lighting in reverse for sabotage protection

Glare, the anathema of lighting engineers, is now being welcomed as an ally in the present defense the saboteur. The above illustration shows how this principle of light glare is being used at a war-materials plant to blind an intruder, while the guard remains inconspicuous in the shadows. Anyone approaching the plant sees only the blinding spots of light, while guards behind the light can see clearly anyone approaching.

The luminaire design used in the scheme is a Fresnel lens, in reality a miniature lighthouse beacon, which throws a flat, fan-shaped beam of lighting with great efficiency. A row of these luminaires is set on posts several feet away from the buildings to be protected, aimed so their light is projected slightly downward away from the buildings. The space between the luminaire and the buildings is virtually in darkness.

FWA working toward centralized control

Washington Correspondence

The Federal Works Agency, since Gen. Philip B. Fleming took over as administrator, is swinging toward a considerably more centralized way of doing things—toward something closer to a real department of public works. The now semi-autonomous agencies included in FWA—U. S. Housing Authority, Public Buildings, Public Roads, WPA, the remnants of the Public Works Administration—seem headed toward the same status as that of the bureaus in any of the old line departments.

So far the change is more in spirit than in structure. But where John Carmody, the former administrator, saw his job primarily as one of coordinating the work of the various agencies under his command, Gen. Fleming is inclined to keep a tight central control over their detailed operations.

First attention, naturally is going to FWA's war jobs—housing and emergency public works. In the past there has been almost no connection between the two programs despite the fact that they deal with two aspects of the same problem—expanded war employment in communities unequipped to deal with it. The two jobs are now to be tied together under the supervision of Baird Snyder, who came over with Fleming from the Wage-Hour Administration as special assistant. Snyder has been with Fleming for years, is practically his alter ego.

This is going to mean that negotiations with local agencies on housing and public works will often be pulled together into one package. It will sometimes mean that when utilities are needed for a war housing project, they will be installed by the agency doing the housing and charged to the emergency public works fund. It should make possible the formulation in a war-expanded community of an integrated program of temporary housing, permanent housing and public works.

First expression of the new tendency is in the organization set up to handle the temporary housing program (page 75). Reorganization of the permanent housing program is held up until the conference committee on the Lanham Act amendments decides whether to require that the job be done entirely by the Public Buildings Administration or to give the administrator a free hand in the choice of agencies.

The well-authenticated rumor of Nathan Straus' resignation as head of USHA points to a deal by which Congress would leave the choice to the administrator. Much of the pressure to give the job to PBA arises from Straus' personal unpopularity in the House. On this assumption, most of the permanent housing would go to USHA and PBA.

Photo by Bachrach

Maj. Gen. Francis Wilby to head West Point

The War Department, last week, announced the appointment of Maj.-Gen. Francis B. Wilby, Commander for the First Corps Area, U. S. Engineers, Boston, Mass., to be superintendent of the U. S. Military Academy, West Point. General Wilby succeeds Maj.-Gen. Robert L. Eichelberger, who has been assigned to command a combat division.

General Wilby was educated at Harvard University, and at the U. S. Military Academy, West Point. After graduating from the Army Engineer School he served in Cuba, the Philippine Islands and China. He went to France in 1917 with the A.E.F., after having served as director of the 1st Corps Engineers School, and later as assistant in charge of engineering in the Office of the Chief of Engineers, he was appointed to command the 1st Engineer Regiment, 1st Division, Corps of Engineers, National Army, with the rank of Colonel.

After World War I he returned to the grade of major in the regular army, and having graduated from the General Staff School, became a member of the War Department General Staff, serving in this capacity from 1924 to 1928. He was made division engineer of the North Atlantic Division with headquarters in New York City, and in 1939 was appointed Chief of Staff of the 1st Army.

Ralph Budd resumes duties as president of C.B. & Q.

Ralph Budd, who for a year served as defense transportation commissioner in the transport department of the advisory committee to the Council of National Defense, has resumed his duties as president of the Chicago, Burlington & Quincy Railroad. His decision followed the establishment by President Roosevelt of the Office of Defense Transportation in the closing days of 1941, with Joseph B. Eastman, chairman of the Interstate Commerce Commission, as its head.

Army acquires record size lumber stockpile

In preparation for increased defense construction activities under the "Victory Program" outlined by the President, the Army last week purchased more than 700,000,000 b.ft. of lumber. The purchase was handled by the Materials and Equipment Section of the Construction Division, Office of the Chief of Engineers, and is believed to be the largest transaction of its kind on record for any single buying agency, public or private. The lumber was acquired under the "auction system" established by the Army nearly a year ago for the central purchasing of large quantities of defense materials. The magnitude of the transaction may be realized from the fact that the total amount of lumber bought by the Army during 1941 was but 2,000,000,000 b.ft. Between 80 and 90 different sizes were involved in the order.

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Civil engineers appointed to arbitration panel

Announcement of the appointment of four members of the American Society of Civil Engineers to the National Panel of Arbitrators was made this week by Cornelius Vanderbilt Whitney, president of the American Arbitration Association and chairman of the Board of Pan-American Airways. They are: Frederick H. McDonald, of Charleston, S. C.; T. C. Forest, Jr., of the firm of Rollins & Forest, Dallas, Tex.; J. N. Pease, president of J. N. Pease & Co., Charlotte, N. C., and Edward H. Prentice, former city engineer of Binghamton, N. Y.

The four new appointees join a national panel of approximately 8,000 qualified and carefully selected experts in their respective fields who are available to the association to act as impartial arbiters when called upon.

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Fatal fire in bunkhouse of big construction camp

Fire sweeping through a large bunkhouse of the camp of the Foundation Company of Canada for the Shipshaw power development on the Saguenay River in northeastern Quebec early Sunday morning caused the loss of 15 or 16 lives and the injury of many other men in the bunkhouse.

The Foundation Company of Canada is engaged in building a power plant that ultimately will have a capacity of 1,000,000 hp. for the Saguenay Power Co., a subsidiary of the Aluminum Company of Canada, which has a great aluminum reduction plant on the Saguenay River at Arvida, Que.

Sand bag barricades used with asphalt admixture

Sand bag barricades are being made more durable and more effective in San Francisco by the addition of 3 percent of 60 penetration paving asphalt mixed with hot sand before sacking. In addition to much greater resistance to shrapnel and splinters, the improved method prevents sand "run" when the burlap is cut and does away with frequent renewals required by rapid decay of sacks containing wet sand.

When sand bag barricades began to come into vogue for important buildings in San Francisco, city authorities cast about for more satisfactory materials or methods. Burlap life is too short, they said. Even creosote treatment lengthens the life of the burlap to only about six months if wet sand is used. Consideration was given to several admixtures. Lean cement admixtures, which would have to be sacked wet, would not stop the tendency of the burlap to rot and would make a relatively expensive job.

Experiments made with asphalt showed that if the sand is well dried by being heated to about 250 deg. F., the admixture of 3 percent (by weight) of 60 penetration asphalt will develop, after moderate compaction, a firm bond in the sacked material. As this hot mix remains plastic for several hours, heating, mixing and sacking can be done at some plant where street paving materials and equipment are kept, trucking the sacks of hot stuff to the barricades and there tamping them into the desired shape.

For sand bag barricades around public buildings at San Francisco, 60 penetration asphalt was mixed in a pug mill with sand that had previously been brought up to the desired temperature. Materials were dumped in in batches of 970 lb. of sand and 30 lb. of asphalt. Output of this mill was sacked by a 2-man crew at the rate of about 200 sacks per hour. (After two days' experience, a one-mixer crew filled 1550 sacks in 6 hr.). About 160 lb. of the mixture was put into each sack. Filling sacks to only 60 percent of capacity leaves the necessary amount of play for the tamping required to develop the desired cohesion and resultant hardness of the mix. The ordinary hand tamper used on asphalt paving is satisfactory. Each sack should be tamped flat to give the pile stability.

After cooling and hardening, material put up in this way holds its shape firmly even if the burlap is entirely cut away. The hot, dry condition of the material when sacked and the water-repellant characteristics of the mass are expected to give long life to the burlap.

The 3 percent asphalt content was arrived at by testing various percentages between a too-friable low limit and an unnecessarily-sticky high limit. The 3 percent mix with moderate compaction is remarkably firm and solid, and gives a very low-cost barricade. San Francisco prices are as follows: sacks, $7.50 per hundred, sand 75c. per ton, asphalt $7.50 per ton. A fine-grain sand is desirable for the best results.

This work at San Francisco has been done under general direction of A. D. Wilder, director, Department of Public Works and Preston W. King, superintendent of streets.

Sand that has been sacked while hot, after a 3 percent asphalt admixture, will hold its shape in barricades even if the burlap is later torn away.

Construction started on Key West water line

Construction has been started on an 18-in. steel water line from Florida City, Fla., on the mainland to Key West, for use of the naval operating base and to supply the city of Key West. The line, which is about 130 miles long, will have a 3,000,000 gpd. capacity, and is being constructed at an estimated cost of $3,750,000.

Since abandonment of the Florida East Coast Railway service following the hurricane of September, 1935, the city of Key West has had to depend for its fresh water supply on rainwater catchment into cisterns.

The project is being carried out by the Bureau of Yards & Docks, U. S. Navy. Williams Bros. Corp., Tulsa, Okla., holds the construction contract, estimated to be $1,000,000. Parsons, Klapp, Brinckerhoff & Douglas and E. T. Killam, New York, N. Y., are consulting engineers.

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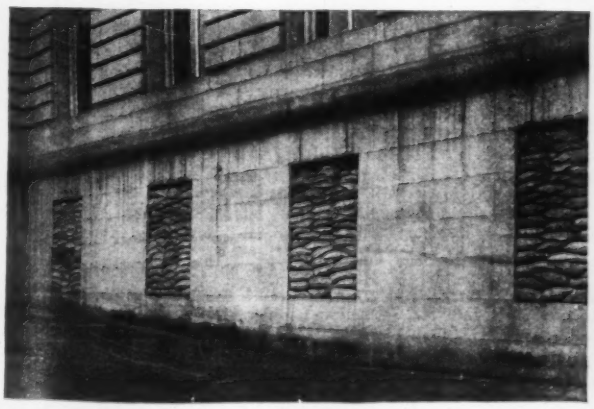
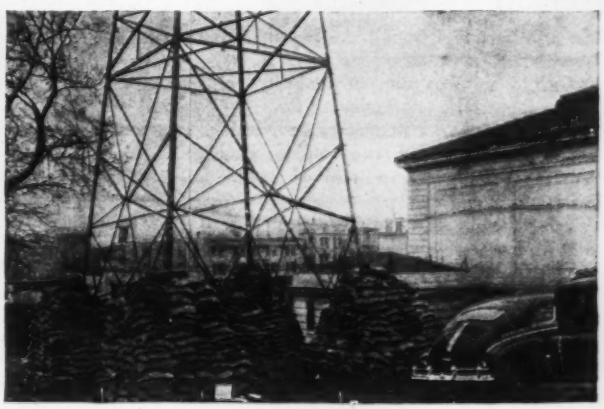
TVA engineers to map New York strategic areas

Engineers of the Tennessee Valley Authority will map an 8,000-sq. mi. region of strategic war importance in New York State, Gordon R. Clapp, general manager of the authority, has announced. To be done at the request of the Army's Corps of Engineers, the work will cost approximately $1,500,000, and is scheduled for completion by July 1, 1943.

Ned H. Sayford, chief of TVA's maps and surveys division at Chattanooga, Tenn., will direct the mapping program. TVA is one of six federal agencies engaged in this strategic mapping work. The others include the Army, the U. S. Geological Survey, the U. S. Coast and Geodetic Survey, the U. S. Forest Service and also the U. S. Soil Conservation Service.





Window and radio tower barricades made with burlap bags filled with asphalt-treated sand and tamped into place while hot

Last call for priorities on non-defense houses

All contractors or builders who need priorities assistance to complete construction of privately-owned non-defense housing projects are reminded that the final date for filing applications for such assistance has been set by the Office of Production Management for Jan. 31. After that date, Federal Housing Administrator Abner H. Ferguson advises that no applications for priorities assistance will be received by local FHA offices, which process such applications for the OPM.

It was pointed out that under OPM preference rating order P-71, that any privately-owned non-defense house or housing project to be eligible for priorities assistance must have had the foundations in place before Oct. 9. If the foundations under the main part of each structure to which the application is to apply were not completed before Oct. 9, that structure does not qualify. The application must be made on OPM Form No. PD-135.

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Louisiana presents bill for Army damage to roads

Recent Army maneuvers in the Southern states caused damage to roads and bridges in Louisiana estimated at more than two million dollars. The Louisiana State Highway Department has filed claims totaling $2,013,689 with the U. S. Public Roads administration.

Field men with automatic recording instruments reported that traffic in the area during the maneuver period rose from a daily average of 40,762 vehicles to 95,023 vehicles daily, an increase of 133 percent above the traffic volume recorded at the same points during 1940.

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North Carolina to pool surplus waterworks parts

In an effort to forestall the possibility of confusion in an emergency and interruption to services due to inability to obtain materials, and parts for machinery, waterworks managers in North Carolina have started work on a program for establishing a pool of waterworks equipment parts.

Under the direction of T. S. Johnson, state director of civilian defense, each waterworks station in the state is listing available surplus parts and materials, and a committee from the North Carolina section of the American Water Works Association is expected to be named in the near future to administer the pool in cooperation with Warren H. Booker, of the State Health Department.

JOBS OF THE WEEK

CANTONMENT BUILDINGS, Fort Huachuca, Ariz.
Del E. Webb Construction Co., of Phoenix, Ariz., Ford J. Twaits Co. and Morrison-Knudsen Co., Los Angeles, Calif. will build 639 cantonment buildings, and utilities for complete Triangular Division Camp. Contract awarded by U. S. Engineers, Fort Huachuca. Cost is estimated at $11,000,000. Headman, Ferguson & Carallo, Phoenix, Ariz. are architects.

POWERHOUSE SUPERSTRUCTURE, Fort Peck, Mont.
Fegles Construction Co., of Minneapolis, Minn., has been awarded a contract for constructing power house superstructure and surge tank building, installing penstocks and butterfly valves for Fort Peck Project, by U. S. Engineers, Kansas City, Mo. at a cost of $3,407,026.

ADMINISTRATION BUILDING, Cleveland, O.
Sam W. Emerson Co., Cleveland, O., will construct administration building, engine research building, electric power transforming and distribution system and refrigeration system, as well as foundation for wind tunnel, office and shop buildings for National Advisory Committee for Aeronautics, E. R. Sharp, construction administrator, Langley Field, Va. Project was let on cost-plus-fixed-fee basis at $3,642,425.

TANK ARMOR PLANT, Granite City, Ill.
Frazier-Davis Construction Co., St. Louis, Mo. will build plant to produce tank armor for War Department, for General Steel Castings Co., Eddystone, Pa. Estimated cost of construction is $3,268,000 and equipment will amount to $10,731,500. Giffels & Vallet, Inc. and L. Rosetti Associate, Detroit, Mich. are engineers. Defense Plant Corp. will finance.

BRIDGE, New Jersey
Ole Hansen, of Atlantic City, N. J. has received the contract to build Beach Throfare Bridge and approaches in Atlantic County at a cost of $1,167,013. New Jersey State Highway Department, Trenton, made award.

DREDGING, New York and New Jersey Channels
Great Lakes Dredge & Dock Co., New York, N. Y. will dredge Section 7, Rock Area 12, of New York and New Jersey Channels. Contract awarded by U. S. Engineers, New York, N. Y., at a cost of $816,628.

EARTH DAM, Houston, Tex.
Macco Construction Co., of Clearwater, Calif. has been awarded a contract by the Harris County Flood Control & Improvement District for constructing 10 mile long earth dam with concrete capping and outlets. The project known as the Barker Dam is under the supervision of the U. S. Engineers, Galveston, and will cost $1,767,872.

REFINERY, Port Arthur, Tex.
Lummus Co., New York, N. Y. will construct 100 octane gasoline refinery plant, for Gulf Refining Co., Port Arthur. Estimated cost is $2,800,000.

CANTONMENT, Alexandria, La.
Perrilliat-Rickey Construction Co., of New Orleans, La., will construct cantonment for new Army division. U. S. Engineers, New Orleans, La., will be in charge. Estimated cost is $1,000,000.

SEWAGE DISPOSAL PLANT, Stamford, Conn.
Thompson Starrett Co., Inc., of New York, N. Y. has been awarded a contract to construct sewage disposal plant for city of Stamford, Conn. Cost is $855,226. W. Raisch, New York, N. Y., is architect. Solomon & Keis, Troy, N. Y., are engineers. Contract for incinerator was awarded to Pittsburgh-Des Moines Steel Co., New York, N. Y., at $131,000; and contract for outfall sewer was placed with Paul Bacco & Son, Stamford, at cost of $177,334.

TANK ARSENAL, Detroit, Mich.
O. W. Burke Co., Detroit, Mich., will construct 1 story, rein.-con., brick, steel building for tank arsenal addition for Chrysler Corp., Highland Park, Mich. Total estimated cost is $18,875,000. Albert Kahn and Associates, Detroit, Mich., are engineers and architects.

POWDER PLANT, Merrimac, Wis.
Mason & Hanger Co., Inc., New York, N. Y., has been awarded a contract to construct powder and acid plant by Hercules Powder Co., Wilmington, Del., for War Department. Cost is $65,000,000. Defense Plant Corp. will finance. This corrects report published *ENR* Nov. 13, under Jobs of the Week.

NOTE—Additional bidding and contact news on over 800 projects large and small appear in the Construction News sections beginning on page 201.

Mid-west chapters of A.G.C. hold important meeting

(*Continued from page* 77)

expected loss of revenue will complicate the roadbuilding financial picture.

New officers elected

Four of the five groups installed new officers: J. F. Parker, Springfield, is the new president of the Illinois chapter, while former president, J. E. Dippold, Edwardsville, remains on the board as vice-president, E. S. Hurwich, Springfield, is treasurer. New board members are P. F. Loiselle, Kankakee, and Leo O'Neill, Champaign. Milo P. Flickinger remains as excutive secretary.

At Des Moines E. M. Dusenberg, Clear Lake, Ia., went in as president of Central Branch. E. B. Spencer, Waterloo, Ia., and F. H. Carlson, Decorah, Ia., are new vice presidents. O. W. Crowley, executive secretary, was presented a watch as a memento of 20 years of service.

The Kansas Contractors Association elected Wm. Shears, Hutchinson, as president; M. Clare Miller of McPherson as vice-president, and added Grant Stannard of Wichita to the board. J. W. (Bill) Ballard is still engineer-secretary.

Larry Winn, Kansas City, Mo., was installed as president of the Kansas City Chapter, along with J. E. Dunne as vice-president. Harry Palmer is executive secretary.

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Chlorinators installed at Phoenix stand by wells

To insure purity of waters drawn from its emergency, or standby, wells held in readiness in the event of any emergency which might interrupt the normal sources, the city of Phoenix, Ariz., has borrowed five chlorinating machines from the swimming pools run by its park department and installed these machines at the emergency wells.

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Water facilities to be augmented at Mt. Vernon

Characterizing the matter as "one of grave concern," the Illinois Commerce Commission has directed the Illinois Iowa Power Co. to design and begin construction of a new impounding dam, reservoir and other facilities to augment the water supply of the industrial city of Mt. Vernon in Jefferson County.

To be constructed on Two Mile Creek, whose watershed is directly upstream from the watershed of the city's present reservoir, the new project is expected to provide an additional storage capacity of 485,000,000 to 585,000,000 gallons.

In its orders to the company, the commission mentioned that during 1940 and 1941, and in other years, Mt. Vernon had suffered a water shortage due to the inadequacy of its present supply facilities. In 1941 water was hauled into the city by tank cars to make up for a shortage.

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Illinois leads the nation in concrete highways

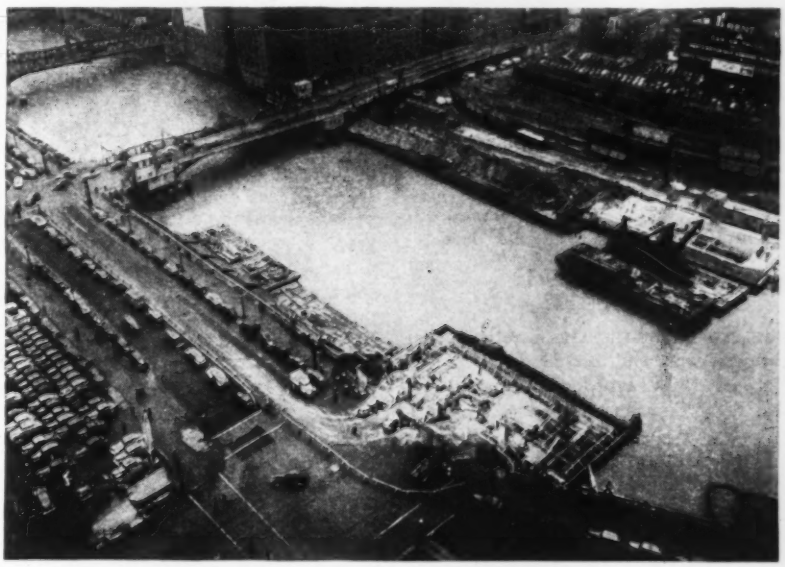
The State of Illinois expended an estimated total of $17,298,000 on highway construction and improvements during 1941, according to an announcement just made by Director of Public Works and Buildings, Walter A. Rosenfield.

Construction of approximately 122 miles of concrete pavement was laid during the year. Illinois leads all states in this type of highway construction. There are a total of 13,154 miles of concrete roads in the state. An additional 36 miles of concrete pavement are now under contract.

Housing project largest in U. S. under way

Ground has been broken at Chester, Pa., for a $3,575,000 defense housing development, said to be the largest in the United States. Leo A. Kirk, Federal Housing Administration director at Philadelphia, states that the new development, to be built on a 66-acre plot, will provide 783 homes. Approximately 35 percent of the plot will be used for houses, the remainder being utilized in landscaping, recreational facilities, and a shopping center. The houses will be of brick and stone construction, two stories high, and each will have six rooms and bath.

The project will be privately financed through arrangements with the Connecticut General Life Insurance Co., of Hartford, Conn. Construction will be carried out by the Wilmington Construction Co., and Armand Carroll, of Philadelphia, is the architect.



Piers for Chicago's State St. Bridge completed

The two piers, straddling the subway tubes, for the State St. double-leaf bascule bridge over the Chicago River at Chicago have been completed, but construction of the superstructure, for which contract was awarded last spring, has been delayed due to priority difficulties. Partial fabrication of steel for the superstructure has been completed and it is expected that priorities for all necessary steel will be available shortly so that the work can be continued.

The span between trunnions is 245 ft. The bridge will carry two 36-ft. roadways, separated by a 5-ft. center curb, and two 11-ft. sidewalks. Each bascule leaf will weigh 4,200 tons. A $1,276,848 contract for the superstructure and operating equipment was let to the Overland Construction Co., Chicago, last May.

All foundations are Chicago well type caissons going to rock 110 ft. below river level. Caissons close to the subway structure were sunk by the subway contractor. Heavy transverse steel girders will carry the bridge piers over the subway. Contract for the foundations for the bridge and north approach viaduct was handled by Fitz Simons & Connell Dredge & Dock Co., Chicago. Contract for the approach and viaduct across the railroad yard at the north end has not yet been awarded.

Stephan Muchada, engineer of bridges, Chicago, is in charge of the project, under C. E. Hewitt, commissioner of public works, and W. W. DeBerard, city engineer.

OBITUARY

EUGENE L. BURNS, a member of the Pennsylvania Sanitary Water Board, died Jan. 4 at Philadelphia. He was 53. Mr. Burns was chairman of the Central Delaware County Sewer Authority at the time of his death.

JOHN JOSEPH SWEENEY, an associate civil engineer in the public works department at the Philadelphia Navy Yard, died Jan. 6 at Ardmore, Pa. Mr. Sweeney was a graduate of Villanova College, class of 1912, and for 17 years taught highway engineering at that institution.

EDWARD PROBST, 71, last of the original partners of the architectural firm of Graham, Anderson, Probst & White, Chicago architects, died Jan. 9 at Chicago. Mr. Probst began his career as an architect in 1893, working in the office of Daniel H. Burnham, then the outstanding architect of the Mid-West. Eight years later he became a member of the firm of D. H. Burnham & Co., predecessors of Graham, Anderson, Probst & White. His firm designed many of the outstanding buildings in Chicago including such monumental structures as the Wrigley Building, the Merchandise Mart, Marshall Fields & Co. department store, Union Station, the Civic Opera House, etc. At the time of his death his firm was engaged in the development of the Army's $5,000,000 Borinquen airbase in Porto Rico.

JULIUS T. SODERSTAM, a retired civil engineer who had served the Sanitary District of Chicago for 40 years, died Jan. 10 at Chicago. He was 82.

JOHN L. BOGART, a civil engineer with the Consolidated Edison Co. of New York for 25 years, died at Glen Head, L. I., Jan. 10. He was a graduate of the New York University School of Engineering.

EDWIN J. MCGEARY, 71, general superintendent of the Bessemer & Lake Erie Railroad, which he joined in 1895, died Jan. 10 at Greenville, Pa.

ARTHUR FREDERICK KLEIN, chief construction engineer for Northwestern University since 1935, died Jan. 10 at Chicago. He was formerly vice president of the construction firm of R. C. Wieboldt Co.

COL. HAROLD CHAMBERLAYNE FISKE, 61, U. S. Army (retired), a classmate of Gen. Douglas MacArthur, died Jan. 8 at Manhasset, L. I. Colonel Fiske was graduated third in the class of 1903 at the United States Military Academy at West Point. Upon graduation he was assigned to the Philippines as a second lieutenant in the Corps of Engineers. He remained in the Philippines until 1908, when he returned to West Point as an instructor. During World War I he was attached to the 107th Engineers. He received the Croix de Guerre and the Order of the Purple Heart and was named an officer of the French Legion of Honor. After the war he served in the Rivers and Harbors section of the United States Army Engineers. He retired from the army as colonel in the 6th Engineers at Fort Lawton, Seattle.

ROBERT WEIR, engineer with the city waterworks department of Toronto, Ont., for more than 30 years, died Jan. 3 at Toronto.

JOHN H. MURPHY, 74, for more than 20 years engaged in highway construction, died Jan. 7 at Burgoon, Ohio.

EARL D. MOODY, 34, chief engineer for Consolidated Builders, Inc., contractors for Grand Coulee dam, died Dec. 29 at Mason City, Wash. He was graduated from the University of Washington and was connected with the Wallace Bridge & Construction Co. and Washington Iron Works of Seattle before going to the Columbia Construction Co. as an engineer for Bonneville dam and later, at Grand Coulee.

FRED DAVENPORT, 61, civil engineer, died Jan. 7 at Fort Wayne, Ind.

ALFRED R. DART, 61, WPA area engineer who directed the agency's program at Fort Custer and Kellogg Airport, died Jan. 6 at Battle Creek, Mich.

CONTRACTS AND CAPITAL

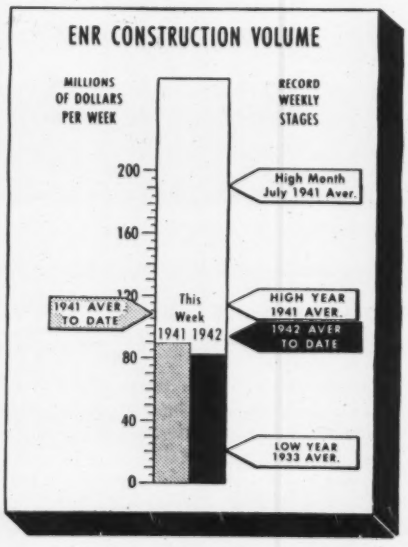
ENGINEERING CONSTRUCTION awards for the week total $83,262,000, a decrease of 41 percent from a week ago, and 7 percent under the volume for the corresponding week a year ago. Public construction is 44 percent lower than last week, but 42 percent higher than in the 1941 week as a result of the 114 percent increase in federal work. Private awards are 9 percent under a week ago, and 70 percent below the total for the week last year.

The current week's total brings 1942 construction to $279,446,000 for the three-week period, a decrease of 15 percent from the $329,541,000 reported in 1941. Private construction, $27,641,000, is 74 percent lower, but public awards are up 12 percent due to the 38 percent gain in federal construction. State and municipal work is 36 percent under the total for the corresponding 1941 period.

In the classified construction groups, gains over last week are in sewerage, and commercial buildings. Increases over the 1941-week volumes are in waterworks, sewerage, public buildings, and earthwork and drainage.

New capital for construction purposes for the week totals $11,005,000, a decline of 35 percent from the volume a year ago. The week's financing is made up of $8,905,000 in state and municipal bond sales, $1,800,000 in corporate security issues, and $300,000 in RFC loans for industrial expansion.

New construction financing for the year to date, $478,692,000, compares with $50,219,000 reported for the three-week period last year.



CONTRACTS

(Thousands of dollars)

	Week Ending Jan. 16 1941	Jan. 8 1942	Jan. 15 1942
Federal	$26,515	$109,107	$56,909
State & Municipal	23,878	19,317	14,827
Total public	$50,393	$128,424	$71,736
Total private	38,781	12,728	11,526
TOTALS	$89,174	$141,152	$83,262
Cumulative 1942 (3 weeks)			$279,446
Cumulative 1941 (3 weeks)			$329,541

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 3 weeks	1942 3 weeks
NON-FEDERAL	$50,219	$28,692
Corp. Securities	5,738	1,800
State & Mun.	30,818	16,592
U.S.H.A. loans	12,043	...
R.F.C. loans	1,620	10,300
FEDERAL	...	$450,000
TOTAL CAPITAL	$50,219	$478,692

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Jan. '42	267.63	128.65
Building Cost	Jan. '42	217.12	117.37
Volume	Dec. '41	217	95

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Unequal Tangent Distances

Sir: The problem of unequal tangent distances at airport runway and street intersections, a solution for which was offered by Joe L. Grimes, Jr., in *ENR*, Dec. 4, 1941, p. 817, can be solved more easily, especially if a calculating machine is available, by the following formulas:

Case I: With Angle D greater than 90 deg. (see sketch) and given R, W_1, W_2 and Angle D find T_1 and T_2.

$A = D - 90$ deg.;

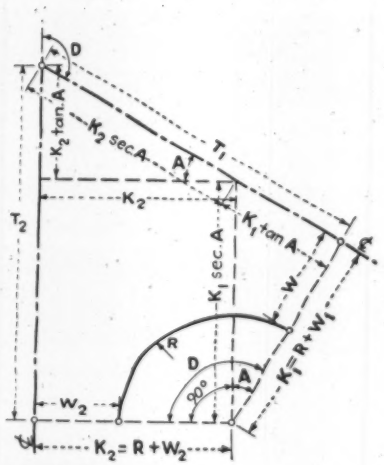
$T = K_2 \sec A + K_1 \tan A$; and

$T_2 = K_1 \sec A + K_2 \tan A$.

In the same way it can be shown than when Angle D is less than 90 deg.

$T_1 = K_2 \operatorname{cosec} D\text{-}K_1 \cot D$; and

$T_2 = K_1 \operatorname{cosec} D - K_2 \cot D$.



Unequal tangent layout

The advantages of the above formulas are that two functions only of the central angle, or its complement, are needed, and that the formulas, being an algebraic sum of products, permit "letting the products accumulate in the calculating machine."

ROBERT G. DAVIES
Civil Engineer
Santa Monica, Calif.

Opportunity for Engineers

Sir: Ten years ago the civil engineering field was decidedly overcrowded. Hundreds of young men were graduating from colleges of engineering and due to the lack of actual field and construction work they were willing to work for little more than practical experience. As a result of this mass production of graduate engineers contractors were able to secure the services of competent men at a very low salary rate, and that rate did not increase in proportion to the engineer's value as the years passed by.

When the young engineer discovered that he was unable to make an adequate wage to supply his needs, he gave up his chosen profession and sought employment in more remunerative fields. Perhaps the value of the engineer has been underestimated, or perhaps it was the over-supply of men that caused the under-estimation; who can determine? But now, the condition has assumed a new aspect, namely, that there exists a vital and immediate need for construction engineers.

As we are now in the state of war, our national defense program has reached such proportions that the federal government has made provision to establish night schools throughout the country to educate young men in the science of engineering. This program was necessary to speed up production, house troops, construct bridges, build superhighways, erect fortifications, establish munition plants and perform other engineering feats that have been neglected heretofore, but are now essential to protect our democracy, and our previously unquestioned freedom.

H. A. BYHANNA
Junior Asst. Engineer
State Road Commission
Moundsville, W. Va.

Transforming Vertical Curves

Sir: Referring to the article entitled "Transforming Vertical Curves," by Samuel Gisser (*ENR*, Nov. 20, 1941, p. 747) Mr. Gisser's problem of changing grades at a bridge and still being able to use the same elevations on the bridge is frequently encountered. In reality the vertical curve is the same in the old and the new, the only change being the location of the P.C. and the P.T. The parabolic constant of the vertical curve must remain unchanged. The problem then is to determine the slopes of these new tangents and to be sure that the P.C. and P.T. are not on the bridge.

Any vertical curve that connects tangents of opposite slope must have either a high or a low point, depending upon whether it is a hump or a sag curve. If we call this point the point of horizontal tangent (P.H.T.) we may locate it directly from the grades given. The relationship is $\left(\frac{G_1}{G_2} - G_2\right)$. This is the horizontal distance from the P.C. The vertical distance from the P.C. is $G^2{}_1 \frac{L}{2}(G_1 - G_2)$.

The old curve P.H.T. is 6/10 times 6 + 00. or Sta. 12 + 60.00. The rise is 6 times 6 times 6.00/20 or 10.80 ft. or elevation 118.48. From this point the second degree parabola extends to plus or minus infinity and the drop is the distance in stations squared divided by 1.2. The number 1/1.2 is the parabolic constant and is equal to the divergence of the tangent and the curve. This in terms of the grades is $(G_1 - G_2)\ 2L$ or $\frac{10}{12}$

From the P.H.T. the equation is $Y = \frac{X^2}{1.2}$ Then $\frac{dy}{dx} = -\frac{X}{0.6}$.

Since the problem is to locate the P.C. with $G_1 = +4$ we get $+4.0$ times -0.6 or -2.4. With $G'_2 = -3$ we get -3.0 times -0.6 or $+1.80$. L therefore is 4.20 sta.

If the solution is correct the parabolic constant is not changed. $\frac{7}{8.4}$ is $\frac{1}{1.2}$ Q.E.D.

From the original parabola $y = \frac{-X^2}{1.2}$ we may have an infinite number and combinations of grades. These grades have a different P.I. but only one P.H.T. For this reason it is easier to work from the P.H.T.

CHARLES MACKLIN
Engineer
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Normandy, Mo.

Engineering News Events of 1941

What happened in 1941 is given in the following chronological summary. Details will be found in the issue of *ENR* for the dates noted in parenthesis.

JANUARY

ALL-TIME TUNNELING RECORD set on the Carleton Tunnel in Colorado with 5 miles being driven from a single portal in 513 days, an average of 50 ft. per day. (*Jan. 9*)

ENTIRE ARROYO SECO PARKWAY at Los Angeles goes into service. (*Jan. 9*)

BOX BUTTE DAM near Hemingford, Neb., started by U. S. Bureau of Reclamation. The $2,560,000 project will impound Niobrara River floodwaters to irrigate 12,000 acres. (*Jan. 16*)

FEBRUARY

CONTRACTS for Atlantic defense bases, totaling nearly $35,000,000, are awarded as Army and Navy rush defense construction program. (*Feb. 20*)

TO FINISH the cantonment program President Roosevelt asks Congress for an additional $575,000,000. Fast legislative action is expected on $1,115,000,000 worth of strictly military construction. (*Feb. 20*)

BANKHEAD TUNNEL, a 3,400-ft.-long vehicular tube under the Mobile River at Mobile, Ala., is opened to traffic. (*Feb. 27*)

BOSTON, on Feb. 15 officially opens its new subway under Huntington Ave. in the Back Bay section. (*Feb. 27*)

FIRST OKLAHOMA irrigation project approved as the Bureau of Reclamation starts construction of the Altus project in Greer, Kiowa and Jackson Counties. Cost is estimated at $5,600,000. (*Feb. 27*)

MARCH

NEGOTIATED-FEE CONTRACT is abandoned by the Constructing Quartermaster Corps of the U. S. Army and a modified form of competitive bidding substituted. Calls for bids, however, will not be advertised. (*March 6*)

CONSTRUCTION included in the fourth supplemental defense appropriation bill, which passes the House, totals nearly $850,000,000. (*March 6*)

GRAND COULEE POWER PRODUCTION begins as two 10,000-kw. station service generators are turned on. Start of operation is two years ahead of schedule. (*March 20*)

ST. LAWRENCE RIVER agreement submitted to Congress as President Roosevelt makes public the Canadian-U. S. Agreement for development of the international section of the stream for power and navigation. Total cost of the proposed work is placed at $266,170,000. (*March 27*)

MUD MOUNTAIN DAM earthfill operations are protected by 328x196-ft. tent. The large canvas, which weighs about 35,000 lb., is suspended between walls of the White River canyon. (*March 27*)

DISMANTLING of the damaged Tacoma Narrows Bridge, which collapsed Nov. 7, 1940, is recommended by a board of engineers retained by the Washington Toll Bridge Authority to investigate the collapse. (*March 27*)

APRIL

BUILDING TRADES DEPARTMENT of the AFL by resolution agrees to bar strikes due to jurisdictional disputes on defense work. (*April 3*)

TEMPORARY DIVERSION INCREASE of Lake Michigan water through the Chicago drainage canal is not favored in the report of a special master appointed by the U. S. Supreme Court. (*April 10*)

HIGHEST HIGHWAY BRIDGE east of the Mississippi River to be built by Kentucky. Roadway of new structure will be 240 ft. above low water on the Kentucky River and 200-ft.-high piers will be required. (*April 10*)

WASHINGTON STATE SUPREME COURT April 12 orders the state toll bridge authority to pay $619,915 to the three contractors who built the collapsed Tacoma Narrows Bridge. (*April 17*)

WPA CONSTRUCTION of the Civil Aeronautic Authority's airport program is recommended by Congress as funds are provided for continuation of the work. This proposal strongly opposed by Jesse Jones and the CAA, who want contract work continued. (*April 17*)

CONSTRUCTION of 32 government-owned shipways, costing about $22,400,000 is arranged by the U. S. Maritime Commission, as an emergency program of building 472 cargo ships gets under way. An additional 56 ways are called for in a $500,000,000 Lend-Lease allocation for new ships. (*April 24*)

FIRST MAJOR DEFENSE HOUSING undertaken by the Federal Works Agency, a $1,935,000 project to accommodate 2,700 persons at Fort Knox, is completed. (*April 24*)

IMMEDIATE CAUSE of the Tacoma Narrows Bridge failure was the slipping of the center cable band on the north cable, according to a report by a special board of engineers appointed by the Federal Works Agency to study the accident. (*April 24*)

MAY

CENTRAL VALLEY power and irrigation project in California is speeded up to deliver power from Shasta Dam in 1944, instead of 1945. (*May 1*)

INTER-AMERICAN HIGHWAY completion through Central America is urged upon Congress as President Roosevelt proposes a $30,000,000 program to improve the route from the Mexico-Guatemala border south to the Panama Canal. (*May 8*)

START of the $41,200,000 Bullshead power project on the Colorado River provided for as Congress includes $5,000,000 for construction in an appropriation bill. Funds also provides for adding additional generators at Bonneville and Grand Coulee Dams and for transmission lines. (*May 15*)

SHASTA DAM concrete placing reaches 1,000,000 cu.yd. May 2 as the placing rate of 6,000 cu.yd. per day is maintained. (*May 15*)

MOST BEAUTIFUL STEEL BRIDGES erected during 1940, as chosen by the American Institute of Steel Construction, were the Susquehanna River Bridge at Havre de Grace; Dunning Creek crossing on the Pennsylvania Turnpike; Klamath River Bridge, Humbolt County, Calif.; and the Oceanic Bridge over the Navesink River at Locust Point, N. J. (*May 22*)

BARTLETT DAM reservoir for Verde River in Central Arizona is filled for the first time since its completion in May, 1939, by torrential rains in that area. (*May 22*)

ENGINEERING CONTRACTS awarded for nine new army cantonments, as the War Department continues its program for preparation against any emergency. (*May 29*)

JUNE

WATER SOFTENING and filtration plant of the Metropolitan Water District of Southern California goes into operation to treat 100 mgd. of Colorado River water, which is delivered via 280-mile-long aqueduct. Thirteen California towns and cities will share the new supply. (*June 5*)

WOLF CREEK DAM, a $55,000,000 project near Jamestown, Ky., on the Cumberland River, is started by the U. S. Engineers. (*June 5*)

STEEL CAPACITY is to be expanded by 10,000,000 tons annually at a cost of a billion dollars at the request of OPM. (*June 12*)

TVA gets $40,000,000 to increase power output for defense purposes. Four new dams are authorized and future plans anticipate construction of three more. (*June 19*)

COMPILATION of projects for a post-war works program is started as the Federal Works Agency sets up the Public Work Reserve. (*June 26*)

NATIONAL AIRPORT at Washington, D. C., completed at a cost of $25,000,000, and goes into service. (*June 26*)

JULY

A PROGRAM to stabilize construction labor wage rates and conditions of employment is worked out by the Labor Division of OPM. (*July 3*)

NEW FORM of fixed-fee contract is adopted by the War Department. The form specifically provides that no increase shall be made in the contractor's fee as a result of changes

in the work, unless the effect of the change is to increase the accommodations by more than 25 percent. (*July 3*)

AN ALL-TIME construction record is established for the first week of July with a total of $298,718,000. This is 25 percent higher than the previous record established Oct. 17, 1940, and is piled on top of a June in which the weekly totals averaged $147,000,000, also a new record. (*July 10*)

WASHINGTON Toll Bridge Authority authorizes the state highway director to prepare plans for a new span to replace the $6,000,000 Tacoma Narrows suspension bridge, which collapsed Nov. 3, 1940. (*July 10*)

MAHONING DAM, for controlling floods on Mahoning Creek in northeastern Armstrong County, Pa., is completed and accepted by the U. S. Engineers from the Dravo Corp., Pittsburgh. (*July 10*)

NEW MAIN ST. BRIDGE across the St. Johns River at Jacksonville, Fla., is opened to accommodate July 4 traffic. (*July 17*)

THE $30,000,000 Quonset Point, R. I. naval air station is turned over to the U. S. Navy's operating force a few days short of one year's work. (*July 24*)

STRIKES on defense projects by unions of the AFL's Building and Construction Trades Departments are barred by an agreement signed July 24 by AFL and representatives of federal agencies concerned with defense construction (*July 31*)

CARLTON TUNNEL, 6-mi. long, $1,000,000 job at Cripple Creek, Colo., is completed 670 days after construction starts. The average daily advancement was 48½ ft. (*July 31*)

A 1,000-FT. flood-control dike and highway embankment along the Connecticut River at Hartford moves 50 ft. into the river July 24 as hydraulic filling for the highway on the fill's top is drawing to a close. (*July 31*)

AUGUST

THE $320,000,000 defense road bill just passed by Congress is vetoed by President Roosevelt, who objects to the bill's mandatory distribution on the regular federal-aid basis of some $125,000,000 for work on the strategic highway network. (*Aug. 7*)

ALLOCATION of $80,810,110 for civil airport construction during the fiscal year beginning July 1 is announced by Brig Gen. Connolly, head of the Civil Aeronautics Administration. Work on 216 of the projects will be done by contract, for which bids will be called in from 60 to 90 days. (*Aug. 7*)

KINGSLEY DAM, a power and irrigation project on the North Platte River near Ogalala, Neb., is officially dedicated. (*Aug. 7*)

NEW CONSTRUCTION in nation during 1941 is estimated at $10,200,000 by the U. S. Department of Commerce. This is an increase of 49 percent over last year. (*Aug. 14*)

CHATUGE DAM started on the Hiwassee River near Hayesville, N. C., as workmen begin foundation explorations. Chatuge Dam is one of four such projects to be built in the Southeast under a $40,000,000 grant from Congress to the TVA. (*Aug. 14*)

FIRST PROJECTS to be undertaken under the $150,000,000 defense public works program are approved by the President. This program, authorized by Congress nearly two months ago, is intended to provide community facilities for local governments whose resources are strained by defense expansion. (*Aug. 21*)

LAKE MEAD, the 150-mi.-long reservoir back of Boulder Dam, Aug. 6, reaches level of the spillway crests for the first time since filling of the reservoir began six and one half years ago. Storage at this level is nearly 31,000,000 acre-ft. (*Aug. 21*)

WASHINGTON Toll Bridge Authority accepts a $4,000,000 insurance payment for damage to the Tacoma Narrows suspension bridge resulting from Nov. 7, 1940, collapse. (*Aug. 21*)

BRIG. GEN. EUGENE REYBOLD, assistant chief of staff of G-4 for the Army, is named to succeed Maj. Gen. Julian S. Schley Oct. 17 as chief of the U. S. Engineers. (*Aug. 21*)

SEPTEMBER

TRANSFER of the construction section of the Quartermaster Corps to the U. S. Engineers is recommended to Congress by the War Department to centralize all army construction. (*Sept. 4*)

DNIEPROSTROY DAM, huge power dam across Dneiper River in Russia, is destroyed by Russian engineers to check the German advance. (*Sept. 4*)

VALLECITO DAM on the Pine River in southwestern Colorado is completed to bring the number of Bureau of Reclamation water storage reservoirs in the West to 80. (*Sept. 18*)

CURRIER LUMBER CO., low bidder on government prefabricated housing project near Detroit, signs closed shop agreement with CIO Construction Workers Organization and thus starts controversy as to scope of AFL agreement with OPM. (*Sept. 25*)

OCTOBER

PRESSURE from AFL causes Federal Works Agency to hold up award of housing contract to Currier Lumber Co. (*Oct. 9*)

THE DOUBLE-LEAF BASCULE railway bridge over the navigation canal at Sault Ste. Marie, Mich. collapses Oct. 7, dropping a locomotive into the canal. (*Oct. 16*)

NIMROD DAM, flood-control project in Arkansas, is completed four months ahead of schedule as workmen employed by Russ Mitchell, Inc., and Bryan & Reese, Inc., raise the American flag over the $3,500,000 dam on the Fourche La Fave River. (*Oct. 30*)

NOVEMBER

PENNSYLVANIA TURNPIKE revenues for first full year are $2,949,383 or $60,000 in excess of the engineer's estimate. Cost of year's operation is $927,000. (*Nov. 13*)

NIAGARA RIVER diversion increase expected as Canada and the United States work out an agreement permitting this country to divert an additional 7,500-sec.-ft. of water for power generation. The agreement is now before the Senate and little delay is expected for the bill's approval. (*Nov. 13*)

FIFTEEN reinforced-concrete barges are contracted for by the U. S. Maritime Commission at a total cost of $9,000,000. (*Nov. 13*)

SHARP LOCAL earthquake at Torrance and Gardena, Calif., Nov. 14 causes no deaths, nor serious injuries, but results in $600,000 property damage. (*Nov. 20*)

BILLION DOLLARS worth of river and harbor projects are approved by a House Committee. Measure includes the controversial $227,056,000 St. Lawrence power and seaway project and the $197,921,000 Florida ship canal. (*Nov. 27*)

GRAND RIVER DAM, $25,000,000 power project in Oklahoma, is taken over by the Federal Works Administrator at President Roosevelt's request. (*Nov. 27*)

LABOR TROUBLES involving welders employed in several West Coast shipyards is settled as nine American AFL metal trades unions agree to grant welders "one-card" privileges and cease alleged discrimination against welders involved in the West Coast shipyard strike. (*Nov. 27*)

BRIG. GEN. PHILIP B. FLEMING, wage hour administrator, is nominated head of the Federal Works Agency as Administrator Carmody resigns because of ill health to take a less strenuous job with the Maritime Commission. (*Nov. 27*)

DECEMBER

ACCESS ROAD and flight strip funds sought from Congress by the President. For access roads he asks $75,000,000 in cash and authority to contract for another $50,000,000. (*Dec. 4*)

BRIG. GEN. BREHON B. SOMERVELL, administrator of the construction division of Quartermaster General's office during the past year, is appointed assistant chief of staff of the War Department, and placed in charge of the supply division. (*Dec. 4*)

WRECKED TACOMA NARROWS BRIDGE towers, originally scheduled to be dropped into Puget Sound, will be salvaged and eventually routed into the nation's defense program, OPM announces. (*Dec. 4*)

BILL transferring construction operations of the Quartermaster Corps to the Corps of Engineers is signed by President Roosevelt. (*Dec. 4*)

WITH only a 30-ft. gap remaining to be closed, first span of the 270–300–270-ft. continuous girder unit of the new Hartford, Conn., bridge collapses, killing 16 men. (*Dec. 11*)

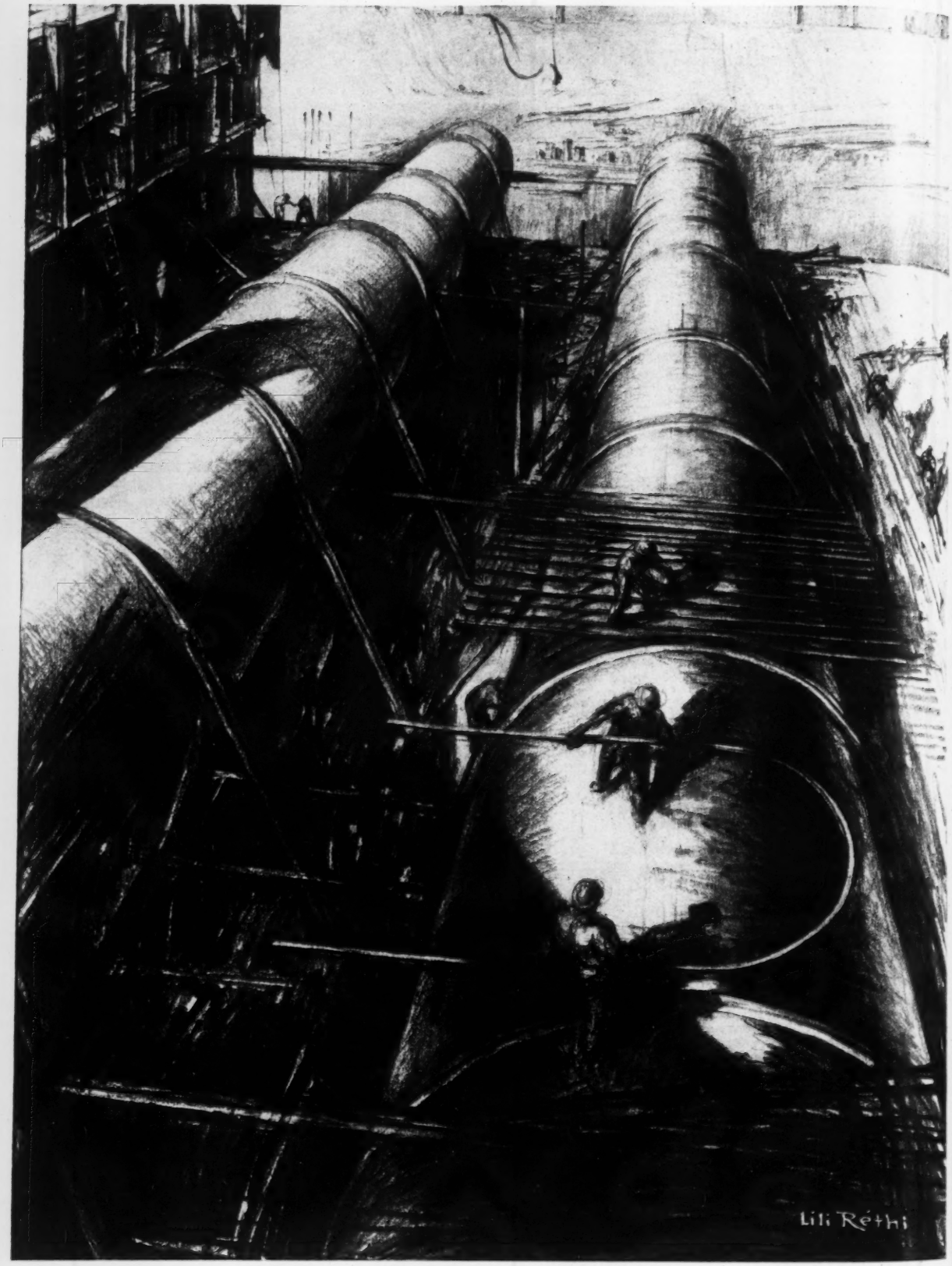
PRESIDENT JOHN COYNE of the Building Trades Department of the AFL announces AFL will sanction no strike by its component unions for the duration of the war. (*Dec. 11*)

THE 10-BILLION dollar third supplemental defense appropriation, containing nearly 3½ billion of construction, is passed by Congress. (*Dec. 18*)

DRAPER-ALPINE TUNNEL concrete work is completed. This 3-mi. project is part of the Salt Lake aqueduct division of the Provo River development. (*Dec. 18*)

DEFENSE HOUSING becomes billion-dollar program as Congress adds another $300,000,000 for the work. (*Dec. 25*)

MUD MOUNTAIN DAM fill on the White River near Seattle, Wash., is topped out. (*Dec. 25*).

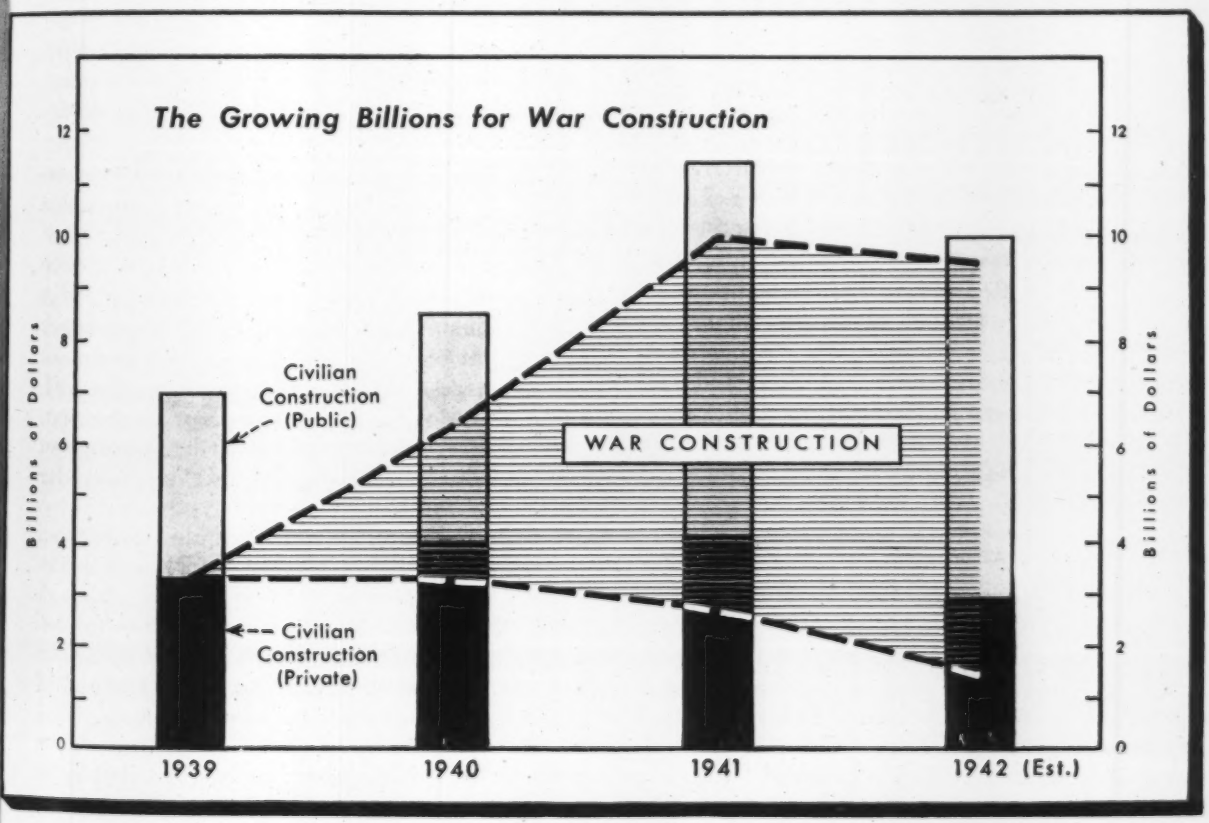


FROM THESE 91-IN.-DIAMETER OUTLETS in Friant Dam 1,000 cfs. of water for the parched fruit orchards of California's San Joaquin Valley will start on its 37-mile journey through the Madera Canal.

REVIEW & FORECAST ★ 1941-1942

BEST EVER but not good enough. In these few words are written 1941's epitaph and 1942's challenge. For eleven months of the past year civil engineers and construction men watched the mounting record of their accomplishments with elation and considerable self-satisfaction. They were building for defense with a speed that exceeded everyone's early expectations. They were overcoming the debility engendered by New Deal use of their industry as an experimental laboratory for make-work schemes during the depression, and were handling more contracts than ever before in history. They could see the total volume adding up to more than eleven billion dollars, exceeding the record of 1928, which had come to be accepted throughout the lean Thirties as a never-to-be-repeated attainment. They were, in short, properly proud of their profession. Then came Dec. 7 and the bombing of Pearl Harbor. Out of the smoke of our wrecked ships and planes arose a new set of values. Records, which meant something when we were only building for defense, lost their meaning

(*Continued on next page*)



when the objective became building for victory in battle. Speed, more speed than ever before, speed limited only by human endurance, is demanded from the construction industry in 1942.

In the months to come civilian construction must be squeezed farther, as the chart on the preceding page indicates. War construction must expand, as the chart also shows; it accounted for 65 percent of the total in 1941, and it may take 80 percent in 1942. Probably the total will be smaller ($10,000,000,000 is estimated) but the war construction share will be nearer 8 billion than the 7 billion of 1941. Munitions capacity already provided must be doubled. New military posts for a greatly expanded army and air force must be rushed. A 100-percent increase in the number of major airfields is contemplated. Industrial housing and defense highways are to be built in expanded volume. The Navy's shore establishments still offer a tremendous backlog of construction. And work on island bases, even in foreign countries, is certain to increase.

More for war, less for civilian needs and none at all for peace and the pursuit of happiness. That is the pattern to which the construction industry must shape its energies from this date forward.

This Issue

THIS ANNUAL REVIEW AND FORECAST was planned with full realization of this shape of things to come. Its sights are set on the future, not on the past. Not only are the reviews of the several technical fields and the annual statistical analysis designed to evaluate past achievements in terms of future usefulness, but four prime problems of 1942 are set apart for discussion by outstanding authorities. In what Walter Binger has to say on civilian defense, General Reybold on living conditions on construction jobs overseas, H. L. Whittemore on material shortages, and Frank Herring on postwar planning of public works, engineers and construction men will get both instruction and inspiration. To the proposition that a difficult future can be forged into proud technical achievement, this issue is dedicated.

Clearing for Action

THE CONSTRUCTION INDUSTRY, in common with other elements of our national economy, began 1941 on a business-as-usual basis. To be sure, an expanding program of defense building had gotten under way in the last half of 1940, but it had been taken in stride. There was still a lot of slack before the capacity of the construction industry would be reached. Defense construction could simply be superimposed on civilian construction. First indications, of necessary reorientation came early in 1941 when engineering employees began to desert their normal jobs for better pay on defense construction. Next, material shortages began to appear, as priority measures were put into effect by the federal government. As huge defense contracts multiplied, more contractors joined forces to effect great construction combinations capable of handling projects of unexampled magnitude at unprecedented speed. Engineering and architectural firms also found it necessary to expand or combine. Many capable engineers and construction men were called to jobs in Washington, or, having reserve commissions in the armed services, were called to duty. Finally the Supply, Priorities and Allocation Board issued its famous order limiting priorities on civilian construction to those projects "necessary for health or safety," and the transition was complete. The construction industry was on a war footing. It is there today.

Labor's Contribution

SUCH RAPID CHANGE was bound to affect labor relations. Compared, however, with the manufacturing industries, construction was relatively free from strikes or disturbances, the CIO not being strongly enough intrenched to create inter-organization disputes and the AFL building trades group exhibiting laudable intentions to solve disputes by arbitration. In an agreement signed with federal contracting agencies and the OPM in July, the building trades unions accepted time and a half for overtime, multiple-shift operation, and a plan to freeze established wage rates for the duration of any given job. For these concessions they received virtual permission to unionize all defense construction and what seemed to be a promise to keep WPA labor off union jobs. In practice, the agreement was not a universal success, but it eliminated most work stoppages. Also, in one instance, the AFL read into it a meaning not apparent in the text, and used it successfully to keep the government from awarding a housing contract to a builder employing CIO labor. Cessation of the vicious work permit scheme, by which tribute was exacted from workmen without making them union members, was also promised by labor leaders, although most of the damage had been done before repentance set in. Labor supply was fairly adequate for all needs, so that there was no large amount of labor scouting, by which workmen are lured from one job to another by offers of higher pay. Since we have been at war, labor has renewed its pledge against work stoppage. The future, therefore, is

not dark, barring some possibility that a large number of workmen may be called into the Army or attracted by higher pay into munitions production.

Construction Costs

FAT PAY ENVELOPES made their contribution to a continuing upward trend in costs of construction during the year. In concert with increased material prices, particularly lumber, the higher pay rates raised general cost indexes from 4 to 6 percent. However, in times such as these, this type of index figure fails to reflect such special influences as overtime, lower labor efficiency and premiums paid for scarce materials, so that the actual cost rise has probably been somewhere between 15 and 20 percent. These "extras" will, of course, continue to exist in 1942, and further cost rises are in prospect. A detailed presentation of the construction cost situation is published on another page of this issue.

Little Slips of Paper

SERIOUS as was the problem of rising costs, it was of little concern compared to that of materials scarcity and its resultant, priority control. By the middle of the year, all the common metals were obtainable only with little slips of paper known as preference ratings, issued by the Office of Production Management; and aluminum, tin and copper soon were virtually unavailable even for defense construction. At first, ratings from A-1 to A-10 were issued, but the tendency to give too many orders an A-1 rating led to subdivisions from A-1-a to A-1-j. At first, too, separate ratings had to be obtained for each materials order, but later entire jobs were given ratings that could be applied to all purchases. Although complicated, the priorities control succeeded in its purpose, which was to direct materials into the channels where they were most needed. But the success had a limit, and that limit occurred when defense requirements began to absorb the entire output of an industry. Then direct allocation was resorted to, under which the raw material producer was told how much he could sell and to whom. The end result was that contractors on war jobs were working under complete priority control, and contractors on civilian jobs, not being able to get preference ratings, were finding it difficult to work at all. The prospect is for an even tighter situation in the construction materials field, with increasing emphasis being placed on the ingenious substitution of plentiful materials for those which are needed for arms and armament.

They Got the Job

DESPITE ITS CROP of vexing problems, 1941 produced a development of great promise in the transfer of all Army construction to the Corps of Engineers. The Navy has always had a single highly efficient design and construction organization in its Bureau of Yards and Docks, but the Army has suffered by comparison because its equally efficient technical branch was not allowed to do the Army's construction. This was reserved to the Quartermaster Corps, which had neither the experience nor the organization to cope with the tremendous construction demands that war emergencies generate. That the Corps of Engineers, which keeps large public works programs going in peacetime, has the training and the personnel to take war construction in stride has been recognized by all the recent Chiefs of Staff, but it remained for the present Under Secretary of War to get Congress to translate this recognition into legislation. As a consequence, War Department construction work enters 1942 on a footing commensurate with the task before it. With the many fine construction officers in the Quartermaster Corps absorbed into the efficient officer group of the Corps of Engineers, the Army has a technical branch that measures up to its every requirement.

The Road Ahead

FOR THE IMMEDIATE FUTURE, life and livelihood depend almost solely upon the fortunes of war. Some engineering firms and some contractors will have more work than they can conveniently handle; others, as a result of the curtailment of normal construction operations, will have little or nothing. For individuals, however, there should be small opportunity for idleness. The new problems of civilian defense loom large. The necessity for maintaining private property and public facilities in the face of a scarcity of usual materials will provide useful and interesting tasks. And there is still the problem of post-war planning, for victory will be hollow if it is merely the prelude to another period of unemployment and despondency. During the past year under the leadership of the National Resources Planning Board, a Public Work Reserve organization was set up to educate cities and states in public works planning and to compile an inventory of possible projects; and Congress gave preliminary considerations to providing funds for advance designs. Thus in present tasks and future planning there exists a full schedule. For it is in 1942 that the foundations will be laid for the new and better world that must be built on the ashes of this war's ruins.

Looking Ahead in Transportation

Present war expected to bring changes as profound as those following the first World War. New emphasis placed on better highway facilities in metropolitan regions.

V. T. Boughton

TRANSPORTATION stands to be advanced as much by developments of the present war as it was by those of World War I. That war started the motor truck on the way to its present high position in our transportation system. This war will advance development of the airplane as a means of transportation in much the same way, for, with our capacity to produce planes increased many fold and with airports greatly increased in number, it seems probable that after the war much more of the traffic that now moves over the ground will take to the air. A great expansion of air transport is in prospect.

Faster road and rail transport

War developments may also bring major changes in road and rail transport. Cheaper and more abundant aluminum and steel alloys seem to assure extension of light metals to freight car construction. Faster and more efficient freight service will be a necessity for the railroad companies if they are to keep more of the cream of their business from being taken away from them by airplanes, just as truck operators skimmed off the most lucrative part of their business in the past two decades. This time, however, the cream-skimming will react on truck operators as well and as a result they may find themselves compelled to join with the railroads in giving new and faster door-to-door delivery that will meet airplane competition. Such a plan will call for construction of modern truck-rail terminals, more extensive use of demountable truck bodies that can be put on rail cars for long-distance hauling and greater use of diesel-powered locomotives. But first of all, it will call for new thinking on the part of most railroad operating officials in the matter of handling high-speed freight traffic. No small part of the present depressed condition of the railroad industry is due to the failure of its officers to meet truck competition with aggression and the pioneering spirit of our early railroad builders.

The vast spending for war preparation raised railroad freight traffic a little above the levels of 1929, the highest year on record, and the speeding up of all defense operations now called for in 1942 should raise this year's traffic to higher levels.

The railroads were not swamped by the October traffic peak, as predicted by many pessimists who remember what happened in 1917. This was due in part to the fact that a large share of the gain in traffic was handled by trucks, but it is due primarily to the foresight of the railroads in planning for fast loading and unloading of cars—which was the real cause of the 1917 breakdown—and in adding new equipment to meet the peak demand. In the first nine months of 1941, the railroads put nearly 60,000 new cars and 425 new locomotives into service.

New railroad construction

A record for new line construction not equaled for many years was made by the railroads in 1941, but it was due almost entirely to meeting the needs of rail service at defense plants. Relocation to remove rail lines from valleys to be flooded by new flood-control reservoirs added a small mileage. The total for the year is expected to be 2,000 miles, as compared to less than 50 miles in 1940.

Maintenance expenditures totaled about $600,000,000 as compared to $497,000,000 in 1940, figures that still are below what should be spent to maintain railroad properties adequately. Economies were chiefly in structures, not in track or equipment. Rail renewals were affected by steel priorities, being considerably below anticipated needs of last January. Similar curtailment appears probable for 1942. It can be continued through a few years at little risk of decreasing safety, but at some added cost for maintenance.

No defense highway policy

Any attempt to look ahead in the highway building field is bound to be confused by the continuing lack of federal policy with respect to defense highway needs. In the early days of the present emergency the War Department drafted a map showing in diagrammatic form the roads that it considered should be brought to specified standards for the defense of the country. The department, however, has never stated which of these roads should have preference over others in the expenditure of available funds. Even now we do not know what road work the War Department considers most essential to defense.

Camp access roads

Building army camps and new defense industries far removed from main highways added another complication to the defense road situation, yet with respect to these roads there was no question as to where they were, only a question of how to get money to build them. Last February the Public Roads Administration reported to the President on the needed mileage of such roads, also on critical deficiencies in the strategic highway network, and made recommendations as to the amounts of money to be appropriated. The President promptly buried that report, and its was not until June that he asked Congress for part of the necessary money. Meanwhile Congress had begun action on defense road legislation of its own, but did not complete action until the end of July, and then the President promptly vetoed the bill because it did not give him a free hand in allocating the money to be spent on the strategic highway network.

Stanley Koch photo for Portland Cement Association

Well paved roads with wide shoulders are essential to the free movement of motorized army units. This is Georgia's 118th Field Artillery en route from Fort Jackson, S. C., to maneuvers in Tennessee over U. S. 41 in Fulton Co., Georgia.

Congress took until November to draft a new bill that met the President part way, and that bill he signed but asked Congress to repeal the parts he did not like. It authorized appropriations of $220,000,000 for access roads and work on the strategic highway system, but all that came of it in the way of actual appropriations was $74,600,000 in the supplementary defense appropriation bill, passed after war was declared in December, and $50,000,000 in contract authorizations, both for work on camp access roads.

This money for access roads will go far toward meeting current needs for such facilities because the state highway departments, the WPA and the Army have done an exceptional job in finding funds for badly needed roads to the military camps and bases.

Still unobligated is about $114,000,000 of the regular federal-aid money for the fiscal year ending next July, and there are on the books further authorizations totaling $137,500,000 for expenditure in the fiscal year 1943, which begins next July. Routine practice in the past has been for the states to draw upon these funds as they need them, Congress covering the withdrawals by appropriations. What action Congress will take under the war emergency is as yet unknown.

Too drastic curtailment

There is growing belief in Washington that the War Department supports the President's position that most road work except camp-access roads can be drastically curtailed. If this conclusion is correct it presages a curtailment of highway construction that might in the end react to the disadvantage of our war effort by producing congestion more seri-

DEFENSE HIGHWAY REQUIREMENTS, AUTHORIZATIONS AND APPROPRIATIONS

	Access roads to camps and defense industries	Strategic network: Allocated to states on regular federal-aid basis	Strategic network: Unallocated	Tactical roads: construction and repair	Advance planning	Flight strips for airplanes	Totals
Recommended by PRA in report to President, Feb. 1	$150,000,000	$100,000,000	.....	$25,000,000	$12,000,000	.....	$287,000,000
Recommended in President's message to Congress in June	$100,000,000	.....	$25,000,000	.....	.....	.....	$125,000,000
Authorizations in Act passed in July and vetoed by President	$150,000,000	$125,000,000	.....	$25,000,000	$10,000,000	$10,000,000	$320,000,000
Authorizations in Act passed in November and approved by President	$150,000,000	$25,000,000*†	$25,000,000	.....	$10,000,000*	$10,000,000*	$220,000,000
Funds included in the December appropriations	$74,600,000 $50,000,000**	.....	.....	.....	.....	.....	$129,600,000

*President disapproved these items but signed the bill.
**Contract authorizations.
†To be matched on a 75–25 federal-state fund basis instead of regular 50–50 basis.

ous than that now existing around most industrial centers.

The Army is interested chiefly in the movement of troops and war machines. If it concludes that the chance of invasion is so remote as to make roads adequate to repel invasion unnecessary it may well say that no money needs to be spent on the strategic network as part of our war effort. That conclusion would be reached on a purely military basis and would take no cognizance of present congestion, which is due in no small part to defense industries. The President likewise seems unconcerned with the serious congestion on many highways that are important elements of our industrial defense effort and the rapid disintegration of others under traffic that will grow daily as our war effort increases.

Serious congestion possible

These are the more serious aspects of the highway situation. Most people will agree that construction of parkways, scenic highways and all roads not needed to reduce serious congestion can be abandoned as a war measure, but to stop construction of roads needed to speed men and materials to defense plants or to postpone reconstruction of roads that are going to pieces under today's traffic would be just as foolish as to keep the railroads from building cars to meet the growing defense load of the next few months.

Increased use of the roads and curtailment of new construction will put an added maintenance load on the state highway departments. This will be offset in part by higher gas tax receipts due to increasing traffic and in part by increased federal participation in work on the strategic network as authorized under the Emergency Road Act of 1941. Most heavily traveled roads are part of the network.

Toll roads

The Pennsylvania Turnpike, first major toll highway to be built along modern lines, completed its first year of service in September. Earnings were very close to estimates, but use of the highway by trucks fell well below predictions. The net income after paying operating costs nearly double the estimate was sufficient to pay interest and amortization charges on bonds issued to finance the state's share of the cost of the work, but when the federal grant of 45 percent of the cost is included, the project is far from being the "self-liquidating" undertaking that proponents of toll highways would have the public believe.

Speed limit cut

Of interest as having a possible bearing on highway designing in the future is the fact that after being operated initially without speed limits, a speed limit of 70 mph. was set on the Turnpike in April following some fatal accidents and a considerable amount of mechanical damage to automobiles due to operating continuously at high speeds. Failure of both mechanical and human elements at these high speeds seems to indicate that even on so-called superhighways designing for continuous speeds above 60 mph. is without economic justification.

Two notable highway projects outside the United States are construction of a highway across the Isthmus of Panama, now scheduled for completion before the spring rains, and construction of the last link in Canada's first transcontinental highway in the wilds of northern Ontario. That road was to have been completed in 1941 but has been delayed by the war.

Inland waterways

Little progress was made during 1941 in the development of inland waterways and, unless waterway advocates succeed in getting the St. Lawrence seaway or the Florida ship canal approved as war measures, there will be little in the way of new developments in that field until after the war. The last link in the 9-ft. intra-coastal waterway along the Gulf coast from New Orleans to Corpus Christi was completed late in the year, except for removal of some silting, opening a through route for barges and small vessels. The lock at Watts Bar Dam on the Tennessee River was put into service in March, opening up about 400 miles of the Tennessee River to 9-ft. navigation; but the full potentialities of that waterway will not be realized until the completion of Kentucky Dam near the mouth of the river, which will supply the missing link of about 200 miles for a direct connection with the 9-ft. channels in the Ohio and Mississippi river systems.

Traffic on the Mississippi and Ohio systems increased considerably during the year.

Construction of a third set of locks for the Panama Canal began actively early in 1941, contracts for large quantities of excavation and for cement for lock structures having been let. A contract authorization of $104,000,000 to speed work on that project was included in the third supplemental defense appropriation bill, passed since war was declared.

Air transport

Commercial air transport made a 30-percent gain over 1940, much of it being due to the demand for faster transportation in connection with defense work. Importance of this service was recognized by the SPAB, which granted the commercial lines permission to order 228 new aircraft within the 18-month period following October, 1941. Late in 1941, mail service was inaugurated over the New York-East Africa section of the New York-Egypt route for which Pan American Airways began construction during the latter part of the year.

Airport construction

Construction of airports under a program designed to fit immediate military requirements as closely as possible to ultimate civil needs was one of the large operations of 1941 and promises to be a continuing operation of considerable magnitude during 1942. Enlargement of the Air Force, as announced since the declaration of war, may even add to the work now on the books. All work done so far has centered in the Civil Aeronautics Administration with the major part of all construction operations carried out under the supervision of district offices of the U. S. Engineer Department. The WPA has directed the remainder of the work.

The first formal move toward federal participation in civil airport construction was made in September, 1940, when the House of Representatives put $30,000,000 and contractual authorization of $50,000,000 in the civil functions deficiency bill upon a request from the President that $80,000,000 be made available to start a six-year program for the construction of 1,900 airports at a cost of about $600,000,000, as proposed by the CAA to meet civil and military needs. Previous to that time something like $190,000,000 of federal money had

been spent on airport work by the PWA and WPA, but no policy of federal aid to airport construction had been established. Before Congress got through with the deficiency bill its total for airport work was cut to $40,000,000.

It should be noted that this money was for civil airports that could be used by military authorities as distinguished from the purely military fields and airbases, for which Congress already had provided nearly $400,000,000.

Present and future work

Work on the initial 250-airport program got under way late in 1940; about midyear Congress added $95,000,000 to complete that program and to add 149 more airports. Further, $40,000,000 of WPA funds were allocated to the same work, the allocations to apply to the fiscal year beginning last July. Work is under way on nearly all the initial 250, some are complete, and work has started on about 15 percent of the 149 airports in the supplementary program.

In November the CAA asked the Bureau of the Budget for $76,000,000 to be added for a further expansion of this civil airport program to cover an unstated number of fields, but before Congress had acted war was declared, and $59,000,000 was included in the third supplemental defense appropriation act to raise the total to 504 fields.

The initial airport program was aimed at providing a sufficient number of airports in coastal areas to permit rapid concentration of military aircraft in those areas for defense purposes, also to permit ferrying aircrafts across the country in concentration movements.

Under the expanded program approved in July, it is proposed to provide at least three large airports (Class III or Class IV) within 100 miles of each tactical station for dispersion of activities and flight training, and a similar number of smaller airports within 200 to 400 miles of each of the advance training schools operated by the Army.

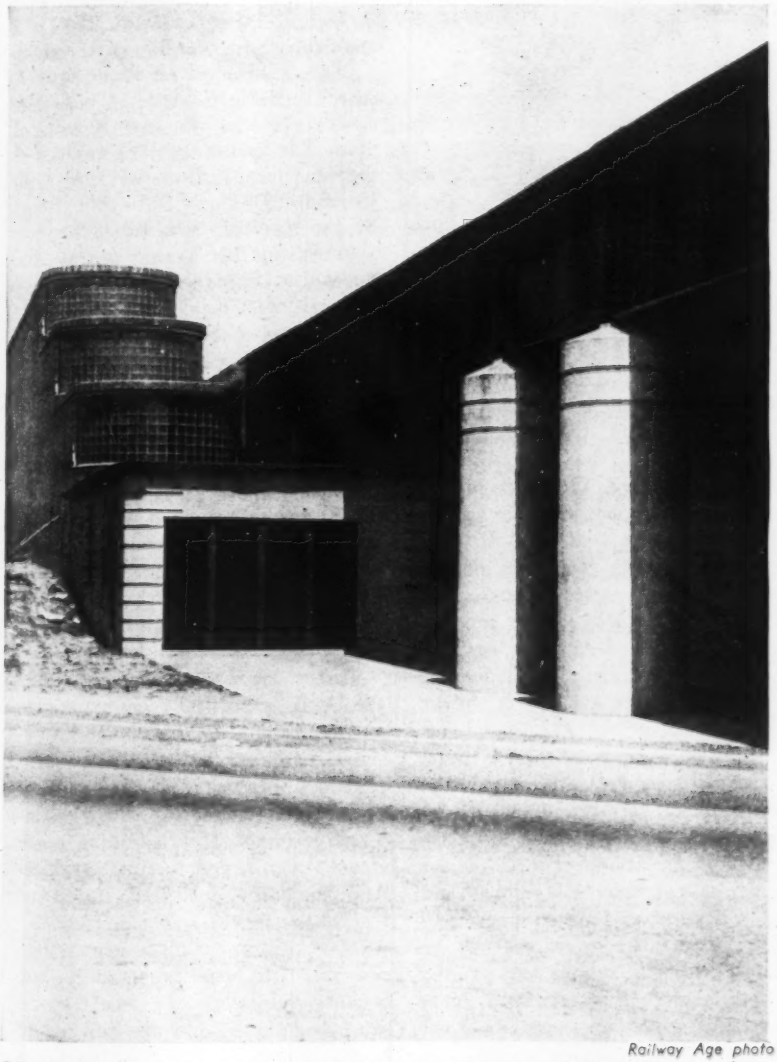
City and inter-city transit

Travel of defense workers to and from their jobs caused an increase in transit riding of more than 5,000,000 passenger per day during 1941. At least one city put its abandoned street cars back into service to meet the increasing travel of defense workers. In many cities bus lines were extended for the same reason. With the greater war effort now planned, and with the restrictions and growing obstacles to the use of private automobiles, a still greater gain in the use of city transit facilities is to be expected.

A growing shortage of new equipment and repair parts is a cause for much concern in the bus industry as is the fact that OPM has set limitations on the manufacture of new vehicles. OPM limitations on the production of new vehicles may cut the rate of delivery below that required to meet increased traffic demands and necessary replacements of outworn buses.

Much traffic in prospect

Looking ahead to the transportation problems of the new year, all indicators point to record-breaking movements of both freight and passengers. New equipment and materials will be at a premium, thus giving added significance to adequate maintenance and efficient operation. Major changes in transportation trends are not to be expected until after the war, but such factors as curtailment of motor vehicle production and the need for more efficient use of all transportation facilities now in service may produce some temporary changes, like the added use of city transit facilities to cut down use of private automobiles. The threatened rubber shortage added to the curtailment of motor truck production might put a considerable amount of traffic back on the rails temporarily.



Railway Age photo

Efficient use of available space and modern design characterizes the new structures built by railroads. This is the North Conduit Ave. station on the Long Island R. R. grade-separation work in the Borough of Queens, New York City.

Bridge Design and Construction

Trend continues toward esthetic and scientific improvement of short-span bridges, while large spectacular structures, of which only a few can be credited to 1941, become scarcer.

Waldo G. Bowman

SOLID but not generally spectacular is a fair characterization of bridge building achievement in 1941. Measured in volume of contracts let, the $120,000,000 total was only slightly below the average for the past 15 years and practically equal to 1940, but few large structures were begun and significant additions to knowledge did not seem to be as numerous as in some other years. The cause of this slower tempo can of course be found in the war construction program.

Although, in general, the profession was too busy with other tasks related to war construction to develop much pressure on the bridge building front, the few achievements that were recorded make a healthy showing. A half dozen different bridges under construction in 1941 would have had a high rating in any year. There was, for example, the Rainbow Bridge at Niagara Falls, whose span of 950 ft. makes it the longest hingeless arch in the world. Its erection by the cantilever method, using an elaborate system of cable tiebacks, was one of the most spectacular jobs of recent times. Use of a dynamometer to measure stresses in the cables was a noteworthy development on the work.

Two other bridges that represent solid technical achievement—over the Mississippi River at Dubuque, Iowa, and over the Chesapeake and Delaware Canal at St. Georges, Del.—are of the tied-arch type, although in quite different variations since the former effects a relatively light tie member and the latter an unprecedentedly heavy one. The light-tie bridge at Dubuque is of the so-called continuous tied-arch type in which the spandrel-braced arch of the center span is continuous with the trusses of the adjacent side spans. The only other bridge of this kind in the United States is over the Meramec River near St. Louis; it was built two years ago and has a main span of 264 ft. compared with 845 ft. for the Dubuque Bridge.

The term "light-tie", as applied to the Dubuque Bridge, is only relative since the tie is a 32x25-in. box containing two 24-in. I-beams and having a maximum section of about 150 sq.in. But in comparison with the 9-ft.-deep, 300-sq.in. tie used on the 540-ft.-span arch at St. Georges, it is light. This heavy tie, which is designed to resist most of the live load moment, permits a very slender rib to be used for the arch.

There were also several other bridges under way in 1941 that had notable characteristics. At Hartford, erection is continuing on a new Connecticut River bridge which will contain, in a 270-300-270-ft. continuous unit, the longest plate girder span in America; on Dec. 4, a tragic accident befell this structure when the almost completed steelwork of the first 270-ft. span collapsed, killing sixteen men. In New York, the Triborough Bridge Authority in its new Gowanus Elevated Parkway introduced a striking architectural design in steel viaducts by using narrow battered-column bents without cross-bracing to support a wide cantilevered deck finished on the edges with a curved plate resembling the leading edge of an airplane wing; it will no doubt be described as streamlined. At least two bridges of the year were built before there was any water under them—the Pit River Bridge in California and the Wax Lake Bridge in Louisiana. The Pit River Bridge is a double-deck railway and highway structure built on the world's tallest piers, 350 ft., which will be almost entirely submerged by the Shasta Dam reservoir; both piers and superstructures were designed to resist earthquake forces, following a pioneer study of seismic analysis procedure by engineers of the U. S. Bureau of Reclamation. The Wax Lake Bridge, a series of heavy simple trusses, which will carry the T&NO Railroad across a new outlet of the Atchafalaya River, was built before the floodway was excavated.

The Wax Lake and Pit River Bridges have another characteristic in common: their truss members utilize perforated coverplates instead of lacing or batten plates. This is a relatively new development, which was the subject of an important research investigation of the year carried out at the National Bureau of Standards under the sponsorship of the American Institute of Steel Construction. Design of the Pit River Bridge members was predicated on photoelastic model studies, but the Bureau of Standards tests involved full-scale steel specimens, and results so far support the belief that perforated coverplates are practicable, economical and safe column material.

While it is the long-span bridge, such as those mentioned above, that attracts individual attention, it is in the field of shorter spans, from 20 to 200 ft., that trends of improvement are most significant because they affect so many more structures. There is, for example, the continuing advancement in appearance of short-span bridges; environmental factors—urban, rural and topographic—are being taken into account in proportioning and detailing; railing designs get closer attention; and simple deck bridges are preferred to through structures. Rigid frames and longer-span beams are finding more frequent utilization in small bridges. And in both short and long-span trusses the use of rolled sections instead of built-up members is growing, not only for better appearance but because shop work is reduced, there are fewer pieces to handle and painting is simplified. Perhaps the most important trend in the small bridge field is the increasing attention being paid to foundations, particularly to

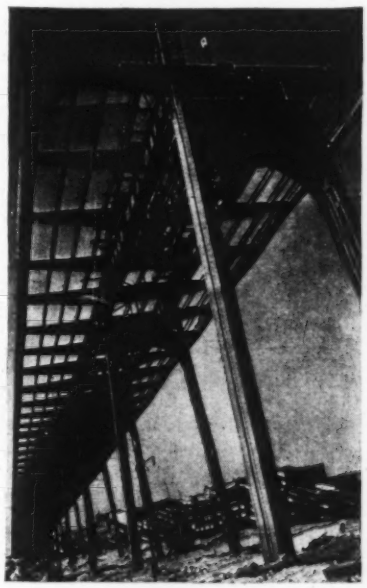
careful subsurface exploration before designs are made.

In the field of movable bridges no significant new structures were begun, but the year marked completion of three large lift spans, 365 ft. at Jacksonville, 332 ft. over the Passaic River in New Jersey, and 224 ft. over the Piscataqua River at Portsmouth, N. H., the latter being a double-deck highway and railway structure. Work continued on Chicago's State St. Bridge, a 245-ft. double-leaf bascule that will have a deck 120 ft. wide. Most notable happening, so far as movable bridges are concerned, was the collapse under a locomotive load of the 27-year-old, 336-ft.-span, double-leaf railway bascule at Sault Ste. Marie, Mich., longest of its type in the world. Apparent cause was a failure of the interlocking system, which permitted a clear signal to be given before the leaves were properly closed and locked to form a simple truss. Damage was relatively slight and repairs were instituted to improve the locking safeguards.

Tacoma aftermath

As a result of the collapse of the Tacoma Narrows Bridge in November, 1940, suspension bridge design practices were widely reexamined during the past year. It seems clear that stability under wind loads must be the first consideration in the design of light, long spans. It furthermore seems agreed that stability should be sought through a decrease in pressure areas or through the use of additional bracing, rather than by increasing dead weight or by strengthening stiffening members. Abandonment of plate girders in favor of stiffening trusses would be in line with the decrease in pressure areas. The use of open grid floors or the venting of curbs has also been suggested. Fairing or streamlining is apparently not placed very high on this list of expedients whose basic purpose is to reduce to a minimum the energy transmitted to the structure by the wind stream.

Turning to the second fundamental or aerodynamic stability, namely to keep the amplitude of vibration within reason, principal discussion centered on more effective bracing. Auxiliary stay systems, as installed on a few originally flexible structures, were in dispute so far as their relative merits are concerned, although both types seem to be proving effective where they have been used. In one case the stays run diagonally down from the tower tops to connections on the stiffening members, while in the other they run diagonally up from the truss-tower connections at roadway level to connections on the main cables. General precedent for both types can be found in Roebling's famous Brooklyn and Cincinnati bridges.



Gowanus Elevated Parkway introduces streamlined characteristics.

Thinking, however, has not stopped with expedients such as stays, but has explored the possibility of more rigid suspender rope systems. One proposal is to use three suspenders at each cable band, one vertical and two diagonal; in effect this creates a truss in which the cable is the top chord and the suspenders the web system. Another suggestion involves the use of inclined suspenders, giving triangular as against rectangular hangar panels. Both ideas have been explored by model studies, which indicate that high damping capacity is provided. In this connection it may be noted that the Public Roads Administration is planning a program of model analysis of suspension bridges in cooperation with an advisory committee of engineers.

As to the Tacoma Bridge itself, the three consulting boards rendered their reports during the year, and found at least one point of agreement, namely, that slipping of the cable band at the center of the north cable, to which stabilizing guys had been attached, was instrumental in throwing the oscillations of the deck out of phase and thus contributing to the failure.

Difference of opinion developed, however, as to re-use of the remaining structure. The FWA board made no recommendation, the state board said towers and cables should be scrapped, and the insurance company board maintained that the bridge could be rebuilt using the existing towers and cables. The insurance companies finally paid $4,000,000 to cover the loss as compared with a $1,800,000 original offer based on re-use of towers and cables, and the decision is to build an entirely new bridge on the existing foundations. Both deck width and cable sag will probably be greater than in the design that failed.

New specifications

A new edition of its bridge specifications was published during the year by the American Association of State Highway Officials. Last revised in 1935, the specifications now reflect modern practices.

Recognizing that war requirements impose special conditions on bridge structures, the Public Roads Administration developed a set of specifications during the year based on A.A.S.H.O. standards, but conforming in detail with War Department suggestions. In general, the modern A.A.S.H.O. loadings designated as H-15 and H-20 are adequate for military loads. An H-15 bridge can carry two lanes of 13½-ton tanks without exceeding allowable stresses. Medium (20 and 25-ton) tanks must cross in single file along the centerline and be spaced 40 ft. apart. They can proceed at any speed, but heavy (55-ton) tanks must reduce speed to 4 mph. and maintain a 50-ft. spacing, if allowable stresses are not to be exceeded. Horizontal clearances for two lanes should be 24 to 26 ft., and preferably 30 ft. A vertical clearance of 14 ft. is adequate.

Bridge building in 1942 may be somewhat less in volume than during the past year. Large and spectacular structures cannot be expected. Technical advance, if it is to continue uninterrupted, must be found in small structures, and concentration of bridge designing talent in this field may produce surprising results.

Action on the Municipal Front

One of the greatest mass migrations of population in our history is piling up new difficulties for public works officials already burdened with other problems of war preparation.

Edward J. Cleary

IN SKETCHING a picture of municipal public works activities since the transition last year from a peace to a wartime economy, an apparent paradox first must be explained. Despite the drastic curtailment of normal public works improvements, the volume of new municipal construction remained at or near the high levels established in previous years. The answer is to be found in what has been described as the greatest mass migration of population ever to occur in this country. Unprecedented demand for the extension of service facilities has occurred in hundreds of industrial communities and in places adjacent to newly established military centers.

With old problems still unsolved and new ones piling up, municipal administrators would hardly characterize 1941 as a year of "business as usual." Rather, events of the past year have called for rapid orientation to changed conditions. Priorities and scarcity of accustomed materials, for instance, posed a broad and difficult problem when applied to maintaining the diverse operations of city service.

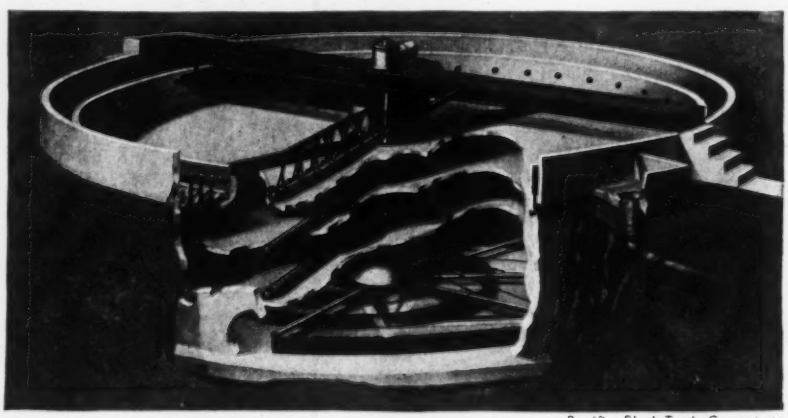
Civilian protection activities also brought complexities, involving assignment of personnel to special duties, the institution of sabotage safeguards, expansion of utility repair service facilities and planning for traffic control during blackout or other emergency periods. Although general plans and procedures are coordinated by a federal Office of Civilian Defense, the ultimate responsibility for civilian protection falls squarely on local units of government; municipalities, therefore, have been brought face to face with the necessity for organizing and operating a new service function.

Prior to the start of defense preparations our cities generally were in better shape physically and financially than ever before. This has helped to cushion the unusual demands now being made upon municipal facilities.

But the situation in those areas where huge new defense plants and camps have been established is described as critical. Estimates indicate that from two to three million persons, exclusive of the 2,000,000 in military service, have moved into these so-called defense zones. For example, San Diego has increased by nearly 100,000 persons; Burlington, Iowa, has nearly doubled in size; Charlestown, Ind., grew from 800 to 18,000 in a few months.

Biggest headache in these boomtowns comes from the search for money to expand street, water, sewer, hospital and school facilities. Some relief was afforded by the establishment of a $150,000,000 federal defense public works fund for construction of community projects "necessary to the health, safety or welfare of persons engaged in national defense activities." Four months after the bill was passed on June 30, however, applications for aid totaling about $850,000,000 had been received from some 3,000 communities. Admittedly, some of these project applications have dubious defense relationships, but the fact remains that there is a wide gap between the money allotted and the money needed. Partial closure of the gap will be accomplished with an additional $150,000,000 appropriated in December.

Attending to tasks concerned with immediate needs is not all that occupied attention of municipal administrators, however. Planning for the post-war depression and for the remaking of our cities was elevated from the status of abstract thinking into the realm of reality. Under sponsorship of the National Resources Planning Board and the Federal Works Agency, an active drive was begun to encourage cities and states in the preparation of long-range work programs. As detailed elsewhere in this issue, the program,



Pacific Flush-Tank Co. photo

Multiple-tray sewage clarifier, which consists essentially of a series of shallow settling basins, has emerged from the laboratory and the first plant installation was made at Springfield, Mo.

known as the Public Work Reserve, will provide a "shelf" of projects, construction of which can be quickly undertaken when and if a post-war depression comes.

More nebulous at present than the Public Work Reserve, but nevertheless receiving serious consideration, are the studies of the Federal Reserve Board for remaking our cities. This sweeping scheme starts with the view that rehabilitation of blighted areas in cities is prevented by inflated land values and by zoning of over-large areas for commercial and industrial purposes. Before reconstruction is practicable, it is argued, these values must be scaled down—and the federal government will have to bear at least a substantial part of the cost.

Turning now from the broader aspects of municipal practice to an examination of developments in the specialty fields of water supply, sewage and refuse disposal, we find that here, too, the defense theme was dominant in 1941.

Water supply development

Plagued by priorities on one hand, and on the other pushed for greater endeavor to meet increasing needs, water purveyors have had to play a difficult role. Despite an OPM order classifying water supply as an essential service, some difficulty has been experienced in getting certain materials for maintenance and extensions; parenthetically, it might be noted that in England materials for public service utilities enjoy a higher priority rating than has been accorded in this country.

Many hubs of industry, of which Baltimore is a prime example, are unable to meet demands for extension of services; the Baltimore water department with 1,136 service requests awaiting installation, refused an additional 500 applications last October because small size pipe was unavailable. And in Philadelphia an $18,000,000 improvement program is reported to be held up because thus far the city has been granted a rating on only half of the 40 priorities for which application was made.

That waterworks men were pushed to provide new facilities is convincingly revealed by the statistics on construction volume. Contracts totaled $76,698,000 in 1941, a gain of 10 percent over the preceding year. The forecast for 1942 is a $80,000,000 expenditure.

Among technical developments in purification practice it is to be noted that phenomenal strides forward were registered in the adoption of breakpoint chlorination for control of taste and odor; more than 80 installations were in operation, compared with 26 last year. Equally interesting is the fact that two plant installations of potential chlorination have been made, one at New Haven and the other at Harrisburg. This technique, long under development by the Wallace & Tiernan Co., provides an electrochemical method of controlling the application of chlorine to maintain automatically a required degree of chlorination regardless of change in flow or change in chlorine demand.

Ozonation, too, put in a strong bid for consideration as a means for reducing taste and odors following the release of operating data from the municipal plant at Whiting, Ind. Here ozone treatment was added to existing filtration, alum, ammoniation and chlorination processes. It was reported, after six months' experience with the industrially-polluted water used by the city, that ozonation did "more than any other treatment in reducing taste and odors in the supply." Prior to use of ozone the hot threshold odor count was as high as 40, but after ozonation the maximum count was only 20.

Further interest in ozone treatment was heightened by the demonstration of a mobile ozonator designed for use with troops on maneuvers and for certain municipal and industrial uses as well. This follows the lead taken by several manufacturers in the development of highly efficient portable and mobile chlorinators.

Achieving a position of substantial importance, particularly in regard to large industrial water supplies, was the relatively new radial-well water collector. Sixteen units were installed this year, the largest project being that for the smokeless powder plant at Charlestown, Ind. (*ENR*, July 31, 1941, p. 155). The seven collector units, each providing 10 mgd., are believed to represent the biggest single groundwater supply in the world.

Some details concerning the proposed revision of U. S. standards for drinking water quality were revealed in a report made public last June by J. K. Hoskins, chief of the sanitation section, U. S. Public Health Service. Major recommendations outlined for consideration dealt with a change in the size of water samples for examination (from 10 milliliters to 100 milliliters); examination of samples from points in the distribution system in addition to those now taken at the treatment plants; daily sampling of supplies when results indicate significant pollution; and higher permissible limits for copper and zinc. The final draft of the recommendation will soon be laid recommendation will soon be ready for approval.

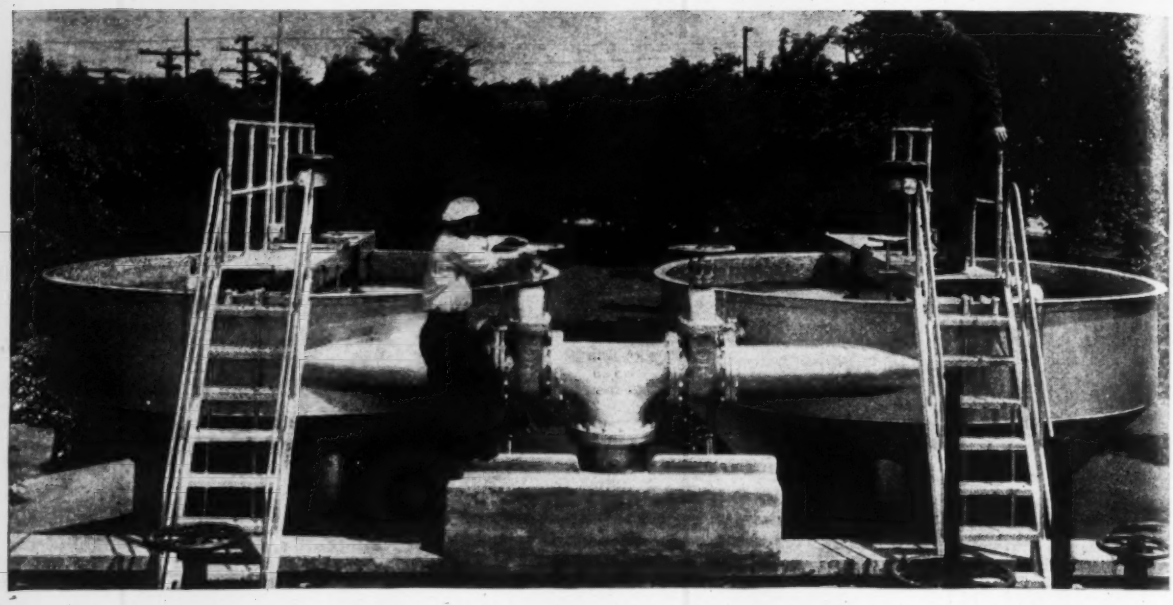
Sewage disposal progress

In the field of sewage disposal there was an expected decrease in new municipal plant installations, but the volume of construction remained quite high—$88,719,000 as compared with $91,467,000 in 1940. Most of this was defense-inspired work resulting from new housing projects, expansion of boomtown facilities and installation of works for large military establishments. Army camps alone accounted for construction of 45 new treatment plants. Others are yet to be completed.

Interestingly enough, nineteen of the Army plants employ high-capacity filtration, a process of treatment that has skyrocketed into prominence within the last two years. Informed estimates place the number of high-capacity installations today at 150, 85 of which fall into the "bio-filter" patented classification, and the balance in either the patented "accelo-filter" or "aero-filter" and certain non-patented types. Largest installations are the 5-mgd. units at the Trinidad Army base, and the 4-mgd. plant at Fort Bragg in North Carolina. Popularity of the process is attributed to its flexibility and ruggedness under varying load conditions, plus lower construction and operating costs than the standard trickling filter system.

Byproduct recovery from sewage, one of the more intriguing aspects of sanitary science, laid claim to more attention than ever before. Aside from the ever-increasing use of sludge gas for driving internal combustion engines (incomplete estimates indicating more than 180 installations producing 35,000 hp.) and the sale of sludge for soil conditioning, even more spectacular developments have occurred.

In July, Baltimore made an agree-



Diffusers for the application of ozone gas go into action at the Whiting, Ind., water treatment plant.

ment with the Bethlehem Steel Co. plant in that city for the sale of treated sewage effluent; faced with a shortage of groundwater used for industrial purposes, the company will pay the city about $24,000 annually for 40 mgd. of effluent. Corpus Christi, Tex., is also selling disposal plant effluent to an oil refinery for condenser water.

Further evidence of the wide interest in byproduct recovery is revealed by studies made in Atlanta, Ga., concerning the use of sludge gas for operating automotive equipment. The findings indicate that the city could save $8,000 annually if municipal trucks were converted to operate on compressed gas instead of gasoline. The scheme was held in abeyance, however, because the war effort made it impossible to get compressors and other equipment; meantime, the gas has been piped to a nearby water pumping station where it is used for boiler fuel, thus saving $6,000 a year.

Among the new devices available for sewage treatment, one of the most interesting is the multiple-tray clarifier. The first installation was completed recently at Springfield, Mo., following several years' experimental work by the Pacific Flush Tank Co. The clarifier consists essentially of a series of trays—one above the other—each provided with a revolving radial arm that serves as a sludge scraper. In effect, this provides a series of shallow settling basins superimposed on each other. A detention period of some 30 min. is said to give results equivalent to those obtained in 1½ to 2 hr. using conventional deep tanks. At Springfield, reduction of suspended solids was 61 percent with a detention period of 33 min. and a flow of 10 mgd.

An important development pointing to better performance from the activated sludge process of treatment was revealed independently from two sources, following announcement of laboratory studies at Harvard and large-scale plant operating results in New York City. Research and practical experience established the desirability of adding sewage in multiple "doses" to the aeration tanks instead of in a single dose as is conventionally done. This practice not only contributes to greater flexibility of control but its adoption makes it possible to carry on operations in tanks 23 to 35 percent smaller in volume than are now required.

Another important contribution to better sewage plant operation was the perfection of equipment for automatic control of chlorination. Using a new principle involving electrical potential measurement of sewage as a direct indication of its condition, the Wallace & Tiernan Co. engineers have provided a means for automatically meeting changes in chlorine demand regardless of variations in flow and characteristics of sewage.

Refuse disposal activities

Salvage of waste materials took a spotlight position in the refuse disposal field, primary emphasis being placed on reclamation of metals and paper. Few cities, however, have included salvage operations as a part of their regularly organized disposal service, but now that we are at war this situation may change.

Many municipal engineers toyed with the idea that tin and iron might be salvaged from the huge quantities of cans collected with household refuse. But an expert analysis of the situation, in pointing to a theoretical annual waste of 25,000 tons of tin on discarded cans, says the cost of recovery is so great that private capital would hesitate to undertake the risk. Recovery of iron from cans may be more feasible.

Grease from garbage is another salvageable product, but the extraction process calls for extensive plant and equipment. A few municipal reduction plants are in operation, notably at Washington, D. C., Philadelphia and Rochester, N. Y., and they stand ready to make some money on an otherwise profitless operation. Prices for garbage grease have gone up in the last year from 3½ to almost 9 cents a pound. At Washington, where a 1,000,000-lb. sale was consummated in October, each ton of garbage yields 45 pounds of grease.

Newest development in incinerator practice is the semi-automatic stoking furnace developed by the Nichols Engineering & Research Corp. It features a circular hearth on which is centered a revolving conical distributor. The first installation is at Port Jervis, N. Y.

War Factories Symbolize 1941 Building

New high in volume and new records for speed mark the defense-stimulated field of building construction. Industrial plants are outstanding, featuring long roof trusses and new wall materials.

J. I. Ballard

MATCHING the National Defense effort stride-for-stride, building construction during 1941 set a new high for volume and new records for speed. During the twelve-month period the majority of this construction divided into three distinct phases: (1) troop housing facilities, (2) industrial plants and (3) mass housing for defense workers. In spite of the demand for speed and more speed in all types of defense-stimulated building work, there have been developments in design, materials and methods of construction which may indicate trends toward future practice.

With almost two-thirds of the total volume of construction work in this country classed as "building construction" during 1941, it approached a record high of approximately four billion dollars. Of this figure about 50 percent was classed as industrial buildings, 15 percent was housing, including military facilities, 20 percent was military other than housing and only 15 percent was commercial and public building work.

Construction of military barracks has followed a well established pattern both in layout and the extensive use of ordinary wood framing, and presents little of notable development. Principal interest attaches to the field operations on the large cantonments, with emphasis on construction organization, planning and supervision. Possibilities of developing new materials for this type of building were explored in the erection of a group of experimental barracks trying both steel and hollow tile. There has been no release of information as to the economic success of these experiments or comparable costs, indicating that there will be no deviation from present standard wood construction in the cantonment expansion program that may be carried out during the present year.

Defense housing became an important phase of building construction during 1941 both as to construction procedure and elements of financing. This phase of the building subject is being treated in a separate article elsewhere in the issue.

The remainder of this review will be confined principally to developments in the field of industrial buildings for defense, which have been notable during the twelve months of the last year.

General characteristics

Outstanding characteristic of the modern industrial plant, as demonstrated by the buildings of 1941, has been the increasing size of the individual structures. Floor areas contained in a single building have approached 25 acres under one roof at several plants.

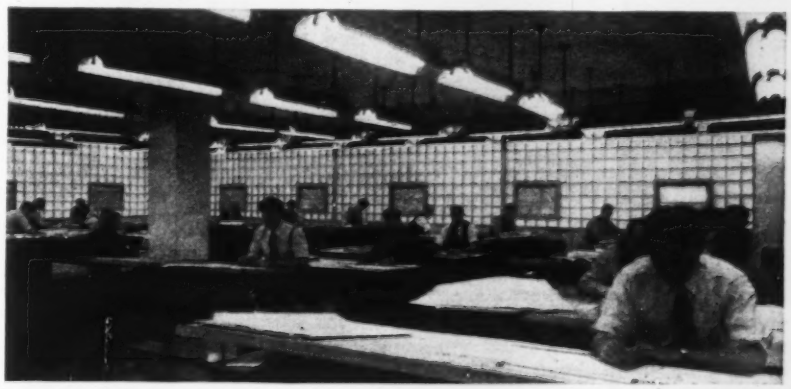
Contrasting with these industrial buildings, which have relatively standard steel framing and roof-truss design, have been the airplane assembly plants for the larger army and navy aircraft, where long-span steel roof trusses and vertical clearances of 35 to 40 ft. have indicated a trend in another direction.

In all of these structures the design has been more or less conventional because of the speed required in getting out plans and the need for using accepted field procedures in the interests of expediting construction operations. Although the framework design provides little indication of trends for the future, there have been distinct developments in such elements as walls, roofs and provisions that relate to air conditioning and ventilation.

Foundations

Foundation practice followed accepted standards for this element of building construction. A notable exception was the extensive use of pipe piles at the Ford aircraft engine plant at River Rouge, where 3,500 tons of spiral-welded steel pipe (10¾ in. dia. and ¼ in. thick) were driven in the form of 2,300 piles.

As a feature closely allied to foundation practice, there has been a distinct trend toward the use of extensive underground galleries for conduits and piping space, to facilitate the distribution of these utilities over large factory areas. The resulting trenching and gallery construction, occupying an increasing proportion of the foundation area, has a normal further development in the idea of full basement space used successfully by the Glenn Martin Co. at its plane plant buildings. Additional cost of such a complete base-



In modern engineering offices plans are prepared for today's buildings.

ment appears to be offset by the space made available for secondary manufacturing use. Such basement areas are usually framed with reinforced-concrete columns, and have moderate vertical clearance under the flat slab of the first floor.

Structural frame

Dictated by plane assembly requirements for large areas of unencumbered floorspace, the trend continues toward long roof trusses. Although the 300-ft. length of roof span has been used prior to 1941, the past year saw additional installations, particularly at the Boeing plant, indicating that this length has been established as both feasible and economical. To secure maximum benefit from these open floor areas, doors of approximately the same width are provided that introduce some special problems in the design of the end trusses.

Equally interesting and significant are the 200-ft. roof spans at the Navy building of the Glenn Martin plant at Baltimore. These trusses of 400-ft. length (two 200-ft. spans) are supported on a center column of unusually heavy design, which carries the lateral load from a wall area 60x100 ft. The wall columns are restricted almost exclusively to supporting vertical loads—a design that is achieved by the use of pin connections at the wall columns. Longitudinal trusses of cantilever type make feasible a 100-ft. spacing of these central columns.

Most notable use of concrete has been in the thin shell type of barrel roof used on a group of Army warehouses, and a large Navy hangar. Design of these structures follows precedent established in previous structures of the type; present interest relates to the span lengths involved and construction procedure using movable forms.

Precasting Concrete Units

Another trend is the interest developing in systems of precasting concrete structural units to be assembled into a complete frame, even including wall panels. In some cases protruding reinforcing bars serve to provide continuity of the frame when embedded in poured girders. There will be more of this type of design and construction for single and two-story buildings of moderate size stimulated by material shortages.

With the exception of footings and lower walls, concrete did not appear as a common material for most industrial buildings built during 1941, with the exception of the rather extensive use for pneumatically placed concrete for wall panels.

Timber construction, which has been used almost exclusively for the extensive troop housing program, and is still the backbone of the defense housing program, is only a minor feature of industrial building construction. An exception was its use for timber roof trusses of 128-ft. span on an airplane assembly plant in British Columbia, and its use for 40-ft. roof trusses in several large motor-repair buildings of the Army.

Walls and roofs

Walls are the elements of modern industrial building design that indicate the most variation in practice. For example, a structure with solid walls devoid of window openings of any type will be announced as illustrating the most modern factory design, while another structure with walls composed almost entirely of glass blocks or window sash will be described with equal emphasis as showing the last word in industrial plant design.

Throughout this wide range of wall design, however, there has been the acceptance of a modern principle, based on the fact that walls are no longer designed to keep the weather out of buildings, but are now emphasized as elements to keep uniform weather conditions within the buildings. This is a natural corollary to the recent emphasis on air conditioning. As a result, walls are now considered more from the point of view of their insulating properties.

Exterior walls may be faced with materials ranging from time-honored brick through modern materials including pneumatically placed concrete, steel panels, asbestos-cement board and precast concrete. Insulating materials in most common use are of cellulose fiber (wood or cane) or asbestos. The latest development is the use of fibrous glass in mats or blankets. In two of the largest bomber assembling plants recently completed for the Army at Fort Worth, Texas, and Tulsa, Okla., the wall construction consisted of metal panels on the exterior side backed by a 1-in. thickness of fibrous glass, a vapor seal, the metal pan of normal wall construction, a 3-in. thickness of glass "wool" for noise absorption and insulation, followed by a retaining mat, also of glass, backed up by painted metal lath on the interior side. This same general type of construction was used for the roof of the two plants. These walls 6 in. thick, weigh 10 lb. per sq.ft., have a coefficient of heat transmission of 0.07 B.t.u. and exhibit characteristics of advantage against bomb and incendiary attack.

Modern insulated wall and roof design, although representing a higher cost, is considered economical in its relation to the operation of air conditioning equipment and the resulting improvement in employee efficiency.

As distinct from the foregoing types of wall designs for industrial plants is the equally interesting development of the past year of precast concrete exterior wall units for a large Navy hospital, emphasizing details of modern casting practice and ingenuity in providing adequate ties.

Installed equipment

Rapid expansion in the extent of air conditioning for industrial plants has characterized the installed equipment feature of modern building construction. Used in the broadest sense, air conditioning varies all the way from forced ventilation to a complete system involving artificial refrigeration, correction of humidity and the cleaning of the air by electric precipitation. Structural design for any industrial plant must now take into consideration the requirements for air conditioning, both as to space which is available for these installations and the provisions for all necessary conduits.

Fluorescent lighting has become almost a standard during the past twelve months for industrial offices and engineering drafting rooms. It is also being used extensively for manufacturing areas that do not require extreme vertical clearance.

Heating plants continue to emphasize the small heating coil units complete with electric fans for distribution of warm air, or the larger direct-fired units with similar blowers for distribution. These heating units, operating as part of the design to control working conditions, are usually regulated to work in conjunction with other elements of the air conditioning equipment.

Housing Hits Its Stride

An unprecedented billion-dollar program sponsored by the federal government presents the opportunity for big changes in building techniques leading to better homes at lower cost.

Edward J. Cleary

RUNNING A RACE AGAINST TIME on a course covered with hurdles, the defense housing program had difficulty in getting under way. But all the hurdles—in the form of policies, personalities, priorities, building restraints and delayed financial appropriations—are being cleared, and the unprecedented program is now beginning to hit its stride. Compared with government-sponsored housing in the last war, when not a single house was complete by the time the Armistice was signed, the present performance is highly laudable. Furthermore, the fast pace has required the streamlining of construction methods, which promises a profound influence on housing in the future.

At the end of the year money had been allocated for some 150,000 dwelling units, about half of which were completed. Principal sources of funds were the $300,000,000 Lanham Act appropriation, $100,000,000 from the second supplemental defense bill of 1940 (equally divided for Army and Navy needs), $20,000,000 for trailers and dormitory facilities, and $32,000,000 from funds previously earmarked for the U. S. Housing Authority slum clearance projects. The request for an additional Lanham Act appropriation of $300,000,000 made by the President last July, finally was approved late in December; also approved was another fund of $300,000,000 for "temporary" housing, included as part of the third supplemental defense appropriation bill of 1941. The grand total allotted for defense housing thus has passed the billion-dollar mark.

Bogged in bureaucracy

With almost as many agencies involved as there are types of houses to be built, the administrative phases of the defense housing program have bordered on the chaotic. And the clamor of conflicting personalities has added further confusion. The initial set-up looked simple enough: The new office of Defense Housing Coordinator was established to designate location of projects; and the Federal Works Agency was assigned the job of construction, with the exception of Navy houses.

But this is what happened: Public Buildings Administration, one of the organizations that make up FWA, at first got the biggest share of the work; U. S. Housing Authority, also a division of FWA, was asigned some work in addition to completing slum clearance projects that were quickly adapted to defense housing purposes. Later FWA created the Division of Mutual Ownership Housing, and then established an additional Division of Defense Housing. Not important, but something for the record, was FWA's direct dealing with three local authorities (Akron, Cincinnati and Washington, D. C.) to serve as construction agents for the government. Also engaged to construct dwellings were the Farm Security Administration and the Tennessee Valley Authority. These six groups, in addition to the Navy, have been the principal public housing agencies. The defense Homes Corporation, an RFC-sponsored organization provided with $10,000,000 venture capital, has appeared in the picture, but actually it has done very little; potentially it could borrow money from banks under Title IV, FHA-insured loans, and thus build $100,000,000 worth of houses.

Private housing activities, too, have felt the stimulation of federal influence through liberalization of mortgage-insurance requirements; but private housing, unless it was in a designated defense area and in the low-rent type, met rough going in the face of required priorities for materials.

Bogged down in bureaucracy the

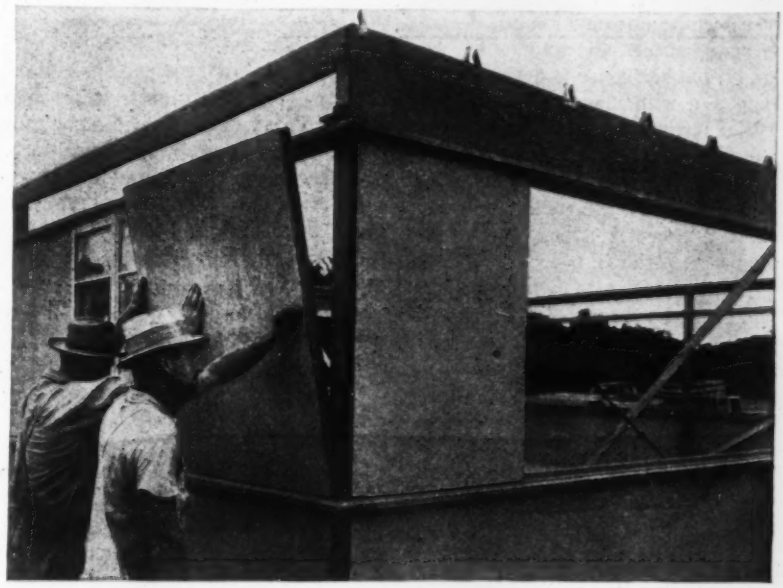


Fig. 1. Horizontal, single-wall construction system developed by the John B. Pierce Foundation is one of the significant developments in the low-cost house field. Framing consists of 4x4-in. timber exterior columns carrying a glued plywood girder that supports the wooden roof trusses. The 1¾-in. wall material, which serves as siding, insulation and interior finish, is made of bagasse fiber covered on each side with a thin layer of asbestos-cement board.

wonder is that the defense housing program has gotten along as well as it has. However, extensive reorganization of the administrative structure is in the making. The first step was taken several weeks ago when FWA Administrator Carmody was shifted to another job; Mr. Carmody and Housing Coordinator Palmer frequently did not see eye to eye.

Tradition goes overboard

The impact of this vast program calling for a lot of houses, speedily erected and low in cost, has had a salubrious reaction in the construction field. To meet these objectives, builders had to be jarred loose from traditional time-consuming and costly saw-and-hammer techniques that have been in vogue for centuries. The result has been the introduction of streamlined construction methods, involving the use of precut lumber, site assembly and prefabrication. And many innovations in low-cost house construction, including features of demountability and provision for easy conversion, have made their appearance. Some radical departures from conventional housing concepts also have been given a trial, notably the air-applied concrete house built around a rubber balloon form, and the steel circular grain-bin redesigned for living quarters.

House construction probably will never become a production line operation comparable to automobile assembly, but many ideas developed in connection with mass production industrial methods are finding effective application. Thus, it has become common practice to install temporary sawmills at a housing site where all lumber is precut, notched, and otherwise prepared for installation without any further recourse to field fitting. Erection work, too, is being organized so that the assembly of houses can be scheduled as a series of operations, each performed by a group of workmen specially skilled in their particular functions.

One of the most significant developments is the system patented by the John B. Pierce Foundation of New York, which goes much farther than precutting and simple site assembly. It embodies these features, plus the use of factory-prefabricated wall material and plywood girders; and it incorporates a scientific division of erection labor operations based on time and motion studies.

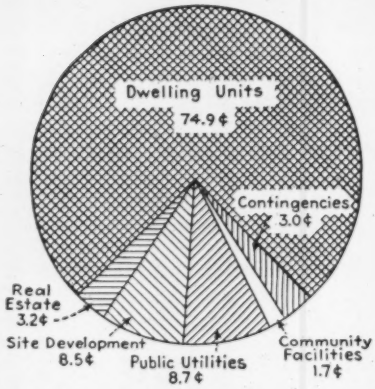


Fig. 2. How the defense housing dollar is spent, as determined by the Federal Works Agency.

Site assembly brings into play factory production methods right on the job. For example, on a 538-family USHA project at Newport, R. I., entire roofs were built on the ground, complete with shingles, and then swung into place with cranes. Operations at Newport centered around a long platform equipped with jigs for laying out frames of whole walls, the lumber having been cut previously to exact size by saws located near one end of the platform.

Prefabrication gets a chance

Proponents of prefabrication, pointing to the economy and speed obtainable with this type of construction, were bitterly disappointed by the government's early failure to embody their ideas in emergency housing. Admittedly, there was some call for criticism, but the problem was not a simple one. First, the prefabricators already in the business were not ready to undertake immediately the volume of work projected, since they had never had enough business to support mass production set-ups. Then, their designs did not include the demountability feature that the government insisted upon. The question of labor's attitude was also important, since the craft unions, particularly, have opposed the introduction of prefabrication (the *cause célèbre* being the Currier case in Detroit, where a low bidder employing CIO prefabricators was not awarded the job because AFL union men threatened trouble).

Focus of much interest has been the Indianhead, Md., "prefab lab" of the Public Buildings Administration. Here ten prefabricators have been erecting some 600 houses both as a demonstration of what can be done as well as to house workers in a nearby naval establishment. Special attention was given to demountabil features, so that the houses could taken down with ease and shipp elsewhere for erection after the em gency is passed.

First demonstration of the th ory that demountable, prefabricat houses can be moved to a new loc tion with ease and at low cost wi be given soon when the FWA orde the transfer of 186 houses from I dianhead to Quantico, Va. Prelimi nary tests made by eight of the con tractors show costs ranging from low of $395 to a high of $763; fiv contractors had costs under $465.

With more than concrete dams up its sleeve, the Tennessee Valley Authority brought to light its experiments with "unit-built" demountable houses. So impressed were FWA officials that TVA was given a contract to furnish 150 houses at Muscle Shoals, Ala. The TVA houses are built in sections, each section being a complete unit of the building, including floors, walls, ceilings and roofs. Fixed in their appropriate places as an integral part of the unit are the electric wiring, plumbing, bathroom, kitchen, windows, screens, floors and kitchen cabinets.

Materials for housing

Lumber, of course, has been the material most widely used for house construction. Steel had a look-in on earlier defense housing, notably in connection with Navy requirements; but now steel is needed elsewhere. Concrete, too, has made its bid for attention in the low-cost housing field, particularly on the West Coast; drawback to the use of concrete, however, is that it is too heavy when demountability and portability features must be considered.

Wallboard materials of all kinds—plywood, compressed fiber, repulped newspaper, and various plaster compositions—have filled important and versatile roles for sheathing exteriors and covering interiors. For weatherproofing purposes asbestos-cement shingles and composition roofing have proven to be big favorites. Special interest is manifested in a weather-resistant insulating board, composed of a core of compressed bagasse fiber covered on both sides with a $\frac{1}{8}$-in. layer of asbestos-cement; it provides a combination of qualities permitting its use as a single-wall material that serves as siding, insulation and interior finish.

Power Dominates River Development

Hydroelectric output stepped up to meet defense needs; flood control continues in important industrial areas; navigation greatly increased but irrigation has been largely deferred as "post-war"

Harold W. Richardson

DEFENSE ACTIVITIES and the advent of war made the control, use and development of the nation's river resources in 1941 more important than ever before. The demand for power, heightened by dwindling storage and river flow in the Southeast, intensified hydroelectric development. Projects planned for the distant future were pulled out of files and hurriedly placed under construction. Additional generating units were planned for early installation in projects already completed, and the power facilities of jobs under construction were enlarged in some instances. In all planning for new projects, those offering power possibilities were given first priority.

What effect war will have on the flood-control program is not yet known, but it is safe to assume that it will result in curtailment or temporary abandonment of all projects not directly connected with protection of defense industries against shutdowns due to floods.

On Aug. 18 Congress passed a flood-control act authorizing $277,825,000 of work on reservoirs and local flood protection works, and the current rivers and harbors bill (introduced into Congress before war was declared) authorizes 36 projects totaling $310,401,000, classified as urgent for defense needs, and additional projects totaling nearly $700,000,000 to serve as post-war public works. Here again, it is to be expected that even the 36 projects classified as having value to defense will be curtailed in the all-out war effort now planned. In support of this conclusion is the fact that the ten-billion appropriation bill passed after war was declared carried only $25,750,000 for flood control.

Three federal agencies

Most of this flood-control and river work is being carried on by the Corps of Engineers. Other major federal agencies concerned with river development work are the U. S. Bureau of Reclamation and the Tennessee Valley Authority.

In November, Reclamation had its $98,000,000 of money for the fiscal year ending next July cut to about $80,000,000 by executive order. Most of the remaining money is for projects having power-producing possibilities, which means that purely irrigation work has been relegated to the background for the present. The TVA, on the other hand, has had its operations stepped up because they help to meet power shortages in the Southeast. Early in the year its budget was increased $10,000,000 to permit speeding up the Fort Loudoun project to bring its 35,000 kw. into use in 1943 instead of 1944, and then in June $40,000,000 more was appropriated for new dams on the Hiwassee River and for additional units at Watts Bar and Wilson Dam on the main river. After war was declared TVA operations were further stepped up by $49,000,000 to build Fontana Dam on the Little Tennessee, two dams at the headwaters of the Holston River, and additions to existing steam and hydro plants of the TVA system.

Power given preference

Power has been given preference in all river work, and there is no doubt but that the Administration has welcomed the opportunity given by the defense effort to advance its plans for public development of the nation's water power resources. Even the great St. Lawrence power project was included in the planning though that power cannot be made available until 1946 at the earliest. An agreement between this country and Canada covering that project was signed in March, and later, when approval of the project by a special act of Congress got sidetracked in the House, the project was dropped into the omnibus rivers and harbors bill along

Flood wall at Huntington, West Va., to protect the city from high water in the Ohio. Behind the wall is the 13th St. West pumping station to handle drainage from the walled area during floods.

PRINCIPAL POWER, FLOOD CONTROL AND IRRIGATION PROJECTS UNDER CONSTRUCTION IN THE UNITED STATES

with the Florida ship canal, where it stood better chance of getting approval.

In July the Federal Power Commission submitted to the President a four-year program covering both public and private power development calling for the addition of one and one quarter million kilowatts of hydroelectric power in the years 1943, '44, '45 and '46 and about two and one half million kilowatts of steam power, largely private, in the same years. Many projects already planned or under way were included. Not to be outdone, the Bureau of Reclamation brought out a program of its own for the region west of the Mississippi, which called for the addition of 9,000,000 kw. by 1947. Neither program got any official recognition from the OPM and little has been heard of either since first proposed.

While this byplay was going on in Washington the field men in both public and private power operations were bending every effort to speed the completion of the greatest possible number of power units. Many of the plants in this speeded-up program will come into service this year and next year when our war effort is expected to be at its peak.

Privately owned electric utilities did a splendid job in meeting the brunt of the nation's growing defense needs, adding 2,712,000 kw. of new plant capacity. This was 538,000 kw. short of the peak load demand of 3,250,000 kw. on their systems and 600,000 kw. behind their schedules due to shortages of materials, priorities and defense demands on the manufacturers. Additions of 3,655,000 kw. are scheduled for this year.

Notable additions to the nation's power plants during 1941 were the first of the 108,000-kw. units at Grand Coulee Dam, largest in the world. Two more units of similar size are now being installed, and six more are on order, which will complete the installation for which the west powerhouse at the dam was designed. A contract for construction of the east powerhouse was let in December.

Boulder Dam became the largest powerhouse in the world late in October when the ninth 82,500-kw. unit was added, bringing the present capacity of that plant to 780,000 kw. Two more of the large units are being installed, and another is on order, leaving only three more to reach the ultimate capacity planned for this project. During the year the Bureau of Reclamation decided to add Keswick Dam and powerhouse to the Shasta development to increase total power production.

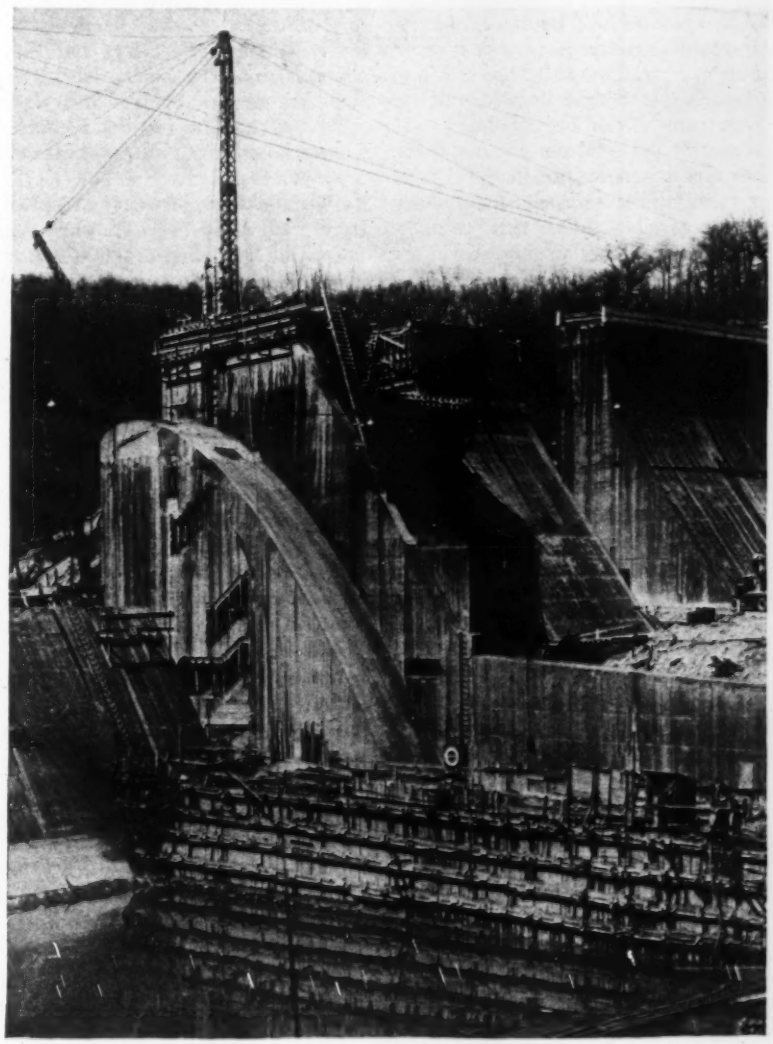
Lake Mead, behind Boulder Dam, was filled to the spillway crests for the first time on Aug. 6, 6½ years after the river bypasses were closed. Below Boulder on the Colorado, work has started on Davis Dam (Bullshead site), a $41,000,000 project with an ultimate capacity of 225,000 kw.

Across the continent, Glenville Dam of the Alminum Company on the Little Tennessee River was put into service in October. It has the highest head of any plant east of the Rockies, 1,215 ft. Nantahala, also an Aluminum Company project, will go into service this year.

Power demands for defense work on both sides of the border at Niagara resulted in agreements between the two countries covering temporary additions to power diversions above the Falls. These added diversions have put back into service old plants that have been idle for years because of obsolescence.

Land reclamation

Though the 1942 budget of the Bureau of Reclamation is less than the all-time record for the preceding year, so much work is of a long-range nature as to make it probable that the bureau will set a high construction record this year. As previously noted, the bureau's work now is largely centered on power, irrigation having been relegated to a decidedly second-rate importance by a ruling that until the present national emergency is past, funds, labor and equipment can be put to better uses than in develop-



Loyalhanna Creek Dam, which will form one of the Allegheny River basin reservoirs to protect Pittsburgh.

ing irrigation projects. The inference is that after the national emergency, when wartime industries slacken, workmen will be released and there will be demand for land suited to irrigation development. Irrigation projects will then be in order, and labor for their development will be available.

Because of prior commitments, a few major irrigation jobs have gone ahead. For example, during the year the All-American Canal was put in service for its full length of 80 mi., thus providing a route entirely on American soil for the main water supply to some 500,000 irrigable acres in Imperial Valley. Excavation on the 160-mi. Coachella branch of this canal was more than half completed. Generally speaking, however, irrigation development has taken a very deep slump.

Flood control

Flood-control work of the Army Engineers can best be visualized by reference to the accompanying map. In no river valley except the Muskingum in Ohio do the dams shown as under construction or completed constitute all the projects contemplated in a comprehensive flood control program for the river system; the dams are, generally, those that can be built most quickly or are dams required for some special purpose. Take the Connecticut as an example: The dams of the current program are but three of a projected twenty for control of floods in that river basin.

Recent demands for power for defense industries have put a new emphasis on multi-purpose reservoirs that either have power possibilities or serve to regulate the flow at power projects farther downstream. Need for protection of industry—as in the case of the airplane plants on the flats at East Hartford, Conn.—has been a determining factor in some instances.

In the Ohio Valley, enough reservoirs have been built or are nearing completion to assure a fair reduction in flood crests at Pittsburgh and other industrial cities in the valley. Further protection is being provided by floodwalls. At Cincinnati work was started on the huge Mill Creek barrier dam that will protect the Mill Creek industrial section from Ohio River backwater. Accompanying floodwalls have not yet been started.

Farther west, at Houston, Tex., the long-planned Buffalo Bayou project will soon get started with a call for bids on Barker Dam, one of three reservoirs to be built in connection with two long by-pass canals.

On the West Coast, protection of defense industries in the Los Angeles area is reasonably assured by completion of Hansen, Fullerton, Sepulveda, Prado and Brea Dams. Work continued on the Los Angeles River improvements, now about 75 percent done, and the Santa Fe earth dam on San Gabriel River was started last July.

Projected work

The large majority of the dams started with funds appropriated following passage of the Flood-Control Act of 1938 are complete or nearing completion. Last year the Army Engineers started work on two large reservoir projects: Norfork Dam on the North Fork River in Northern Arkansas, a tributary of the White River, one of the sources of floods in the lower Mississippi Valley, and Wolf Creek Dam on the Cumberland River in Kentucky. Norfork will store 1,220,000 acre-ft. for flood control. Penstocks for four 30,000-kw. units are being installed but no power plant has been authorized. Wolf Creek will store 5,782,000 acre-ft., and six power units totaling 250,000 kw. are planned but not authorized. Funds for expediting work on these two projects were in appropriation bills introduced into Congress before war was declared.

Four more large reservoir projects were on the Army Engineers' books for an early start when war was declared, and were covered by the same appropriation bill. They are Bluestone on the New River in West Virginia, a stream that has been the center of a long court controversy to determine the scope of the Federal Power Commission's control over power development on non-navigable rivers; Berlin Dam on the Mahoning River near Youngstown, Ohio, the first step in the long-projected waterway to connect the Ohio system with the Great Lakes by way of the Beaver and Mahoning Rivers; Allatoona on the headwaters of the Coosa River in Georgia, a part of the Coosa-Alabama River development program having some power possibilities; and Ft. Gibson Dam on the Grand River in Oklahoma, to supplement Pensacola Dam in the control of floods in the Arkansas and lower Mississippi River valleys.

In addition to these projects for which funds have been asked, the Army Engineers, before war was declared, were giving consideration to an early start on five other projects: Markham Ferry, between Ft. Gibson and Pensacola Dams on the Grand River; Bull Shoals and Table Rock on the White River; Narrows Reservoir on the Little Missouri River in Arkansas, another contributor to floods in the lower Mississippi River, and Whitney Reservoir on the Brazos River above Waco, Texas.

Lower Mississippi work

During the year a total of 82,176,000 cu. yd. of material was dredged from the Mississippi in maintaining a navigable channel, 9 ft. deep and 300 ft. wide at low water stage, from Cairo to Baton Rouge, at a total cost of $3,692,500, including surveys and placing of buoys. In addition, improvement dredging during the year in creating new channels and providing for the stabilization of existing channels and lowering flood stages amounted to 73,687,000 cu.yd. at a cost of $3,743,400. Included was the excavation of pilot cuts for the Sunflower and Jackson Cutoffs, between Helena, Ark., and the mouth of the White River. These pilot cuts were completed early in 1941, and the total excavation amounted to 13,400,000 cu. yd. The river broke through the Jackson Cutoff plug on April 26, 1941, and shortly afterwards the cutoff had enlarged enough to permit navigation. Sunflower Cutoff is ready for opening during the coming flood season. The two cutoff projects have cost $1,092,000 to date.

Flood control in 1942

What will happen to existing and projected flood-control projects in 1942 still is very much of an unknown quantity. An appropriation of $25,750,000 for flood control was included in the third supplementary defense appropriation passed after war was declared, but it is chiefly for completion of projects for the protection of essential defense industries. That no new projects will be started seems assured, and it appears highly probable that some projects now under way may be shut down if there is a shortage of men, machines or materials as our war effort rises to the high levels now anticipated.

Current Construction Practice

Defense construction of the past year has introduced new methods for drydock construction, stimulated prefabrication of building units, and caused extension of winter protection methods. The most significant advances in civil work have been in subsurface construction.

Hal. W. Hunt

PREPARATION FOR WAR has dominated the construction picture during the past year and will be its only objective in the coming year. New plants sprawl over 20,000 to 50,000 acre tracts from the Rockies to the Allegheny Mountains to produce powder and shell for the troops whose housing featured last year's construction. Other work has been under way but the large civil projects have nearly all been based on some phase of the war effort such as production of power for war industries, and roads to camps and defense industries. Priorities and scarcity affected all construction work but most defense jobs had materials and equipment essential to their rapid prosecution. Civil work has waited some for materials, has devised alternate schemes and has used available or salvaged materials.

A characteristic trend in all construction was increased salvage and longer use of equipment as well as utilization of many alternate materials. Better and more regular maintenance of machines to prevent wear was the rule. Many schemes were devised to continue the use of the good portions of partly worn-out equipment. Advances in job welding practices and machines, both oxy-acetylene and arc, contributed greatly to this conservation.

Prefabrication of units made of concrete and wood have had increasingly greater use in building construction. Concrete beams and joists, fabricated to the special dimensions required, have been precast on a vibrating bed, which has permitted use of a mix with only a little more than the minimum water required for hydration. Prefabricated shapes in hollow concrete are on the market for use as columns, girders and roof or floor spans designed for quick erection and easy dismantling.

Timber has been increasingly used for all types of engineering construction with prefabrication of units and use of special connectors a feature. Mass housing for defense workers and families of personnel of the armed forces has become such a major construction branch that a separate article in this issue is devoted to it. According to authoritative spokesmen for the lumber industry, adequate supplies are available for all requirements with even plywood having passed a scarcity stage and being now available for all necessary construction.

Better concrete surfaces obtained on walls, ceilings and floors of housing units have made it practical to leave the concrete exposed on all surfaces in living quarters, thus speeding construction and reducing the cost. Friant Dam in California has used 1,000,000 sq. ft. of absorptive form lining and developed techniques and materials adapted to heavy construction. No re-usable liner material has so far been found.

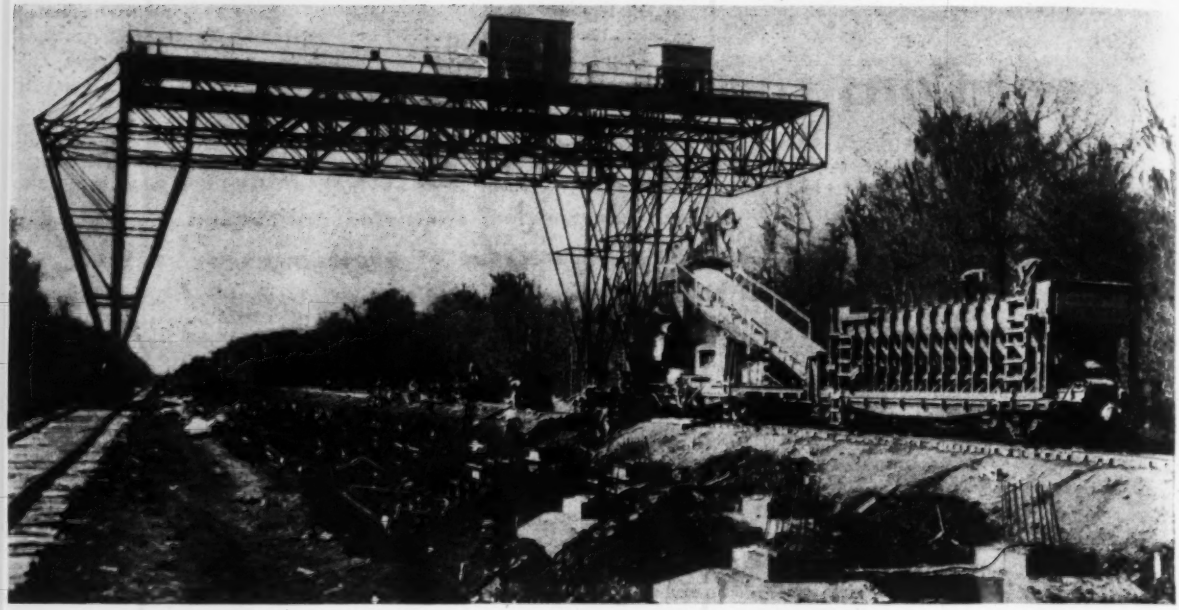
Winter protection

Protection from the natural elements to permit continuous work was practiced more widely than ever before. Some big buildings were completely inclosed for winter protection, the Ford plane engine plant, 360 ft. wide and 1,400 ft. long, being an outstanding example. A tent inclosure was used over the impervious core of Mud Mountain Dam in Washington, over an airport runway paving job in Alaska, and over the deck concreting on the Pit River Bridge. Heating of materials and inclosures is increasingly used to facilitate winter construction.

Radio has entered the construction field for two-way communication systems, particularly on big ordnance plant jobs. Sets are installed in cars and offices of supervisory personnel to provide continuous contact over the several-thousand-acre tracts on which the plants are being built. Most of the installations operate on a frequency assigned to the Signal Corps of the Army.

Possible oil shortage on the seaboard stimulated a good deal of conversation and some construction of pipelines from the producing fields and as short cuts to long tanker hauls, notably from Portland, Me., to Montreal. Perhaps the most significant development in pipeline construction is the introduction of factory-made bends on a 26-in. thin-wall, high-pressure gas line. These bends are supplied in short sections of pipe in varying degrees from 1 to 6, as a single bend, and up to 15 deg. as a double bend in the same length of pipe. This scheme has made it desirable to reduce the number of bends by attempting to keep the bottom of the trench nearly level rather than following the previous practice of setting an excavator for a specified depth below the surface of the ground and field-bending the pipe to fit. Larger side-boom cranes mounted on heavier crawler tractors have made their appearance to handle the long lengths of large pipe.

Loess, a wind-blown deposit of very fine uniform size grains of silica and other minerals, has been found very satisfactory for use in asphaltic paving mixtures for airport surfacing. The material has been used by the U. S. Engineer De-



Concrete is placed by gantry for footings and bents of 8,000-ft. trestle of Missouri Pacific Railroad over Morganza floodway in Louisiana. Railroad car with belt conveyor and 15 batch boxes delivers dry material to conveyor on rail car which carries 1-yd. mixer. The concrete discharges to buckets handled by the traveling gantry.

partment on revetment work for some years because it produced an asphalt mixture that does not require kneading. Extension of use to highway and other paving of this readily available material may be a development of 1942.

New answers to foundation problems

At Hales Bar Dam on the Tennessee River, TVA drilled 18-in. calyx holes as much as 100 ft. deep, starting 50 ft. under water; removed the cores to the full depth of the hole; placed an asbestos-cement pipe in the hole as a liner to prevent the washing out of concrete; and then tremied concrete into place. Repeating this procedure with interlapping holes along the upstream face of the dam, across an area having open horizontal seams and large vertical cavities, has resulted in a concrete cutoff wall expected to stop the flow of water under the dam.

Boulders, muck and other unusual foundation conditions at the site of a 16-story warehouse in Brooklyn required the use of special 30-in. dia. steel caissons driven to rock, sometimes with the aid of a churn drill to pass boulders, and keyed to the bedrock by being drilled into the ledge. After completion and cleaning of each caisson, H-beams weighing up to 466 lb. per lin. ft. were put down inside the caisson as a steel core to carry the load. The H-columns were incased in concrete within the shell for protection and added load-carrying ability. At Beaumont, Texas, Z sheetpile cofferdams were driven using I-beams welded to the sheets to form a combined protection case and supporting structure for bridge piers.

Drydocks

Drydock construction to permit the building of major ships, especially naval vessels, on an even keel, has been a major development of the year. What is probably the world's largest tremie job is being done in connection with this work. Fed by concrete pumps, an effective tremie process has been developed for placing the more than half million yards of concrete under water in drydocks at a Navy Yard. At another yard excavation for the dock was thrown into a berm around the area to make a dike inclosure and was unwatered by deep well pumps, supplemented by wellpoints to assist drainage of the interior side of the dike. Traveling towers, mounted on the berm, support a cableway handling large buckets of concrete into the dock. At yet another yard an ingenious assembly of movable belt-conveyors carries the concrete to its location in the drydock.

A new use for the horizontal radial-well water collector has been found to dewater the initial tunnel excavation at the Brooklyn side of the Battery-Brooklyn tunnel. Pre-draining the sandy soil in this way will eliminate use of compressed air at the start of the work.

Construction equipment

The trend to more and larger earth-moving equipment on big rubber tires has continued during the year with more powerful tractors also put on rubber-tired wheels. Many millions of yards of earth have been moved to make way for camp and plant construction, made possible by the large number of huge earth-moving machines available. Larger machines of the rotary tiller type have been made available for soil mixing, particularly in connection with soil-cement runway construction. Portable continuous asphalt mixing plants with volumetric proportioning of aggregates have been put in operation in several states during the past year.

Many new electric welding machines have made their appearance and older machines have been redesigned to improve the efficiency and speed of the average welder. Advances in the welding art have permitted much more extensive use of this method of fabrication, especially in plant construction where much of the pipe is now welded.

AN URGENT PROBLEM FOR 1942

Civilian Defense —Britain's Example

Walter D. Binger
Commission of Borough Works, Manhattan, New York City

Editor's Note—*Protection of the civil population from the bombs of modern warfare is an engineering problem that quickly assumed reality upon our declaration of war. And it is safe to say that in the months to come every engineer in the country will be concerned with one or another of its phases. Most of the available information is necessarily based upon British experience which Mr. Binger had an unusually good opportunity to evaluate when he visited England last fall as expert consultant to the Secretary of War. In this article he outlines what civil defense means, using blackouts to illustrate some of the responsibilities that lie ahead. Mr. Binger is chairman of the Am. Soc. C. E. Committee on Protection of Civilians in Wartime and of the National Technological Civil Protection Committee, the latter an advisory body to the Secretary of War.*

Before the people of our country take on a set of mental habits which may be induced by exposure to air raids it seems to me that it has become most urgent that every citizen, and more particularly every engineer, examine for himself some of the fundamentals upon which a fair solution of the problem depends. Therefore, let us first define it.

Civilian Defense is the maintenance, during and between air raids, of cities, towns, and the means of transport, in a condition as nearly normal as possible.

This may be considered too broad a definition but I believe that it is not. If the water supply or the gas works are put out of action, if people die of exposure, if the telephone, telegraph and railroad systems are so seriously impaired that business cannot be carried on, civilian defense has not been entirely successful.

The reader is, perhaps, already shocked that I do not place the absolute safeguard of the lives of civilians above all else. But if he is, it is because he has not understood one and perhaps the most important factor of all. *Civilian defense has become an integral part of the means of waging war.* The use of credit, labor and materials to protect the civilian is a function of this greater end and must at all times be subordinate to it. The result is clear. The civilians in air raids will be injured and killed because these three cannot be expended in sufficient quantity for their protection. It is patently impossible to protect the people of even a single seaboard city in a way that any expert would pronounce "safe." At least if this were attempted the efforts of all of these citizens, and of many others besides, towards winning the war would actually cease.

Within the limits outlined above much can and should be done. Here everything depends upon proper timing. While it must be clear from the definition that civilian defense is a civilian matter, namely, one to be handled by the people themselves and their *civil government*, the question of whether an air raid is to be expected, and if so what its probable characteristics and intensity will be, is purely military. When the military authorities have made known to the states and municipalities the probabilities of an attack, it becomes primarily the problem of these governmental subdivisions, or rather of the people living in them, to use the limited materials and equipment, previously made available to them, as well as may be with respect to local conditions then prevailing. Of course certain decisions and rules must be made by a central body, presumably federal, but when the bombs commence to fall "some fine or foggy morn" nobody will even think of that. There is still an ever-present tendency to feel that if worst comes to worst the army will take care of us. It certainly will not. In the first place, it will have been trying to win the war by fighting and training armies, and in the second it will not have the men who by training and experience know about the required things. If the above definition is right the men who managed the works before will continue to do so after.

Let us take as an example the question of "blackout." It is the subject of wide interest in this country at the moment and neither civilians nor technicians know all about it. It may yield some good illustrations of the very things we have under discussion here.

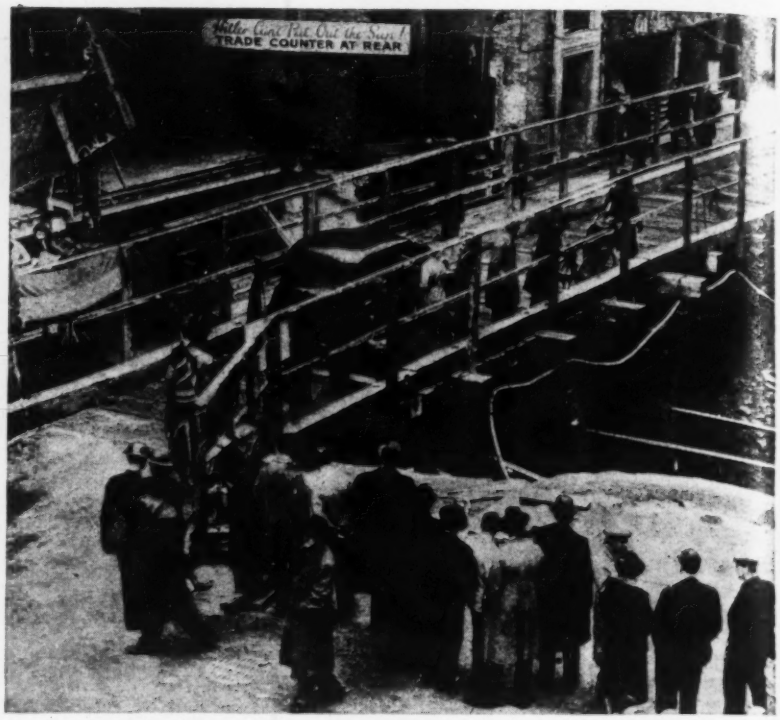
The military, to be sure, would have an interest in whether there was to be a blackout of a great region in which they were not entirely engaged, but it would be a purely secondary one. Of course any hindrance to production might become a matter of military importance but the army is not in general charge of production; certainly not here nor in England and probably not in any other large country. Thus the decision to undertake the blackout with its slowing up of all services, its concurrent accidents, its burden on police and other municipal employees, is a civilian one.

It must be understood that a blackout cannot hide a great city nor even a part of one. The English feel, however, that it is to the blackout that they owe the protection of their principal targets such as powerhouses,

railroad yards, waterworks and other key services. The ratio of the relatively small number of bombs that have actually struck some of these to the number that have peppered the neighborhoods is at least one indication that they are right.

No amount of government planning can create a blackout without the unflagging help of every man, woman and child. "Protect the blackout" are words one hears many times a day in England and sees in print even oftener. Protecting the blackout means not violating it in even the most minor way. In the present state of the art it means primarily having proper curtains, battened down along the sides and deeply overlapping, and never for even one second having them open while there is a light within. But it permeates one's actions to an astonishing degree. While in London I carried an American flashlight of the "fountain pen" type, which had a minute lens the size of a match head. At the very start I was hailed by a policeman for pointing it slightly upward to read a street sign and stopped twice by others who told me to cover the tip with paper since a disk of light was visible on the pavement. The intensity of the blackout from one side of England to the other is astounding and one does not get used to it quickly. It is equally severe in villages and on railroads as in cities.

Certainly we are only on the threshold of our knowledge of the subject. There are other ways, not yet practical, of achieving the same result.



Street traffic in London moves across the temporary bridging of a bomb crater.

An emergency reservoir for fire fighting in an English city is improvised from the basement of a bomb-wrecked building.

Experiments have been made with ultra-violet light which is sometimes called "black light." These experiments indicated that ultra-violet light was not satisfactory because, if used in sufficient power, it becomes visible. This is undoubtedly due to the fact that the wave length cannot be maintained in the invisible range without some stray visible light.

There is also monochromatic lighting, with complementary color in the window panes; thus far not practical because the cost of the special panes to complement the colors is as great as providing for complete stoppage of ordinary light. However, if someone were to devise a cheaper colored pane, or the ideal of one so colored and also shatter-resisting, an enormous stride would have been made.

There are ways, still only rudimentary, to meet the necessity of hiding the luminous steam from cooling towers and gas manufacturing plants. This has thus far best been done by adding carbon to the steam; making black or at least dark steam which is less visible than white.

It will require an effort on our part to examine with the utmost objectivity everything the English are doing and not to copy them blindly. But we must make it. Already one hears in the United States that the fact that the British build their street shelters of reinforced brick is proof that brick is the best material to withstand blast and splinters. An inquiry among English experts will uncover the real reason—they are very short of form lumber for concrete. These shelters must have great inherent stability and be able to move as a unit when struck by an otherwise overwhelming blast. They rest on the surface of the pavement to lessen adhesion. Obviously, a monolithic box has the least tendency to collapse, and if we should build them they should be of reinforced concrete.

Except for the organizing of the civilians for their own protection, and first aid to the injured, I found no part of the entire effort that was not straight engineering technology. Still it apparently took the English some time to realize that this was so true that they needed engineers to get the results they could not achieve with officials who were laymen.

But above all, since it is an engineering matter with which we are engaged, we must have research —efficient, controlled, authoritative, financed. Most of our civilian defense will have to be based on it, and we need it now.

AN URGENT PROBLEM FOR 1942

Construction at Outlying Bases —Living and Working Conditions

Major General Eugene Reybold
Chief of Engineers, U. S. Army

***Editor's Note**—Our active participation in the war makes it more certain than ever that 1942 will witness an expansion in American construction projects outside the continental United States. Thus, more engineers and construction men will have to weigh the problem of working in foreign climes. What General Reybold has to say about living and working conditions at the current jobs on the Atlantic bases, which range from the barren, cold shores of Newfoundland to the jungles of Trinidad and South America, will therefore be of great interest to many readers and their families.*

SINCE THE LATTER PART of 1940, the construction of defense bases on certain outlying islands and coastal areas of the Atlantic, from Canada to the eastern bulge of South America, has been one of the major objectives of the Corps of Engineers, U. S. Army. A great variety of interesting problems has confronted all agencies and individuals directly or indirectly connected with the prosecution of the work. Not only have the locations of these bases, ranging from Newfoundland, at 49 deg. N. latitude, to British Guiana, only 7 deg. north of the equator, caused construction procedures to be varied, but the problems of administration, communication, supply and transportation have been multiplied. Even more interesting, although perhaps less evident, are the factors directly affecting the workers at the sites.

Bases are being constructed in Newfoundland, Bermuda, Jamaica, Puerto Rico, Antigua, St. Lucia, Trinidad, and British Guiana. The variations in climatic conditions, physical geography, and racial characteristics and occupational training of the native inhabitants all had their effect upon construction procedures, and all had to be considered in connection with the planning and execution of the work. A brief review of these

Mess hall at the construction camp in St. Lucia, one of the most scenic islands in the entire West Indies.

factors should aid in visualizing the conditions confronting the workers, and the engineers and contractors supervising the work.

Climate and topography

Newfoundland is situated at the mouth of the Gulf of St. Lawrence. The topography of its 42,000 square miles varies from mountain ranges in the west having elevations of 2,000 to 2,500 ft., to low, swampy land in many other places. The climate resembles that found in coastal New England. In the eastern coastal areas temperatures are rarely below zero in the winter or above 80 deg. in the summer. The average annual rainfall is about 44 in. Newfoundland has a population of almost 300,000 about half of whom live in the Avalon Peninsula on the southeastern tip of the island. Most of the inhabitants are English, Irish, Scotch or French. Fishing and the manufacture of wood pulp are the most important industries. Agriculture is generally difficult. Many of the more important minerals, including coal and iron, are found on the island, but only a few mines have been developed.

The Bermuda Islands are located off the eastern coast of the United States, about 800 miles southeast of New York. They consist of coral deposits on a series of mountain peaks of possible volcanic origin, and are very irregular in shape with a total area of approximately 20 square miles. The climate is very pleasant and no extremes of temperature occur, although in winter there are frequent storms with very high winds. The resident population of 32,000 is composed of 12,000 white and 20,000 colored. During the past ten years about 40,000 tourists have visited the island annually. Local living conditions are exceptionally good, but costs of living are very high.

Puerto Rico, which is about 1,000 miles southeast of the tip of the Florida peninsula, has an area of 3,600 square miles. The climate is typically tropical, with a mean annual temperature of 76 deg. and a daily variation of about 10 deg. on the coast. There is almost daily rainfall. The annual precipitation, although it varies greatly in different parts of the island, averages 77 in. Agriculture has been the chief industry since the discovery of the island, and practically every acre suitable for cultivation has been utilized for the last 200 years. Sugar, coffee, tobacco, fruits and nuts are the principal products. Of the present population, estimated at 1,650,000, 71 percent are white, 4 percent are black and 25 percent are mulatto.

Jamaica, the largest British island in the West Indies, is 90 miles south of Cuba. Its total area is 4,400 square miles, and the topography is generally mountainous; the highest peak reaches an elevation of 7,388 ft. Annual precipitation for the entire island varies from 36 to 104 in. At Kingston, near which the army base is located, it averages approximately 45 in. Temperatures range from 70 to 94 deg., with a mean of 78 deg. Humidity is high, but the trade winds prevent the climate from being oppressive. The present population of the island is about 1,200,000, of which only 2 percent are white. The island is very progressive, however, and over half of the population can read and write. There are over 2,000 miles of paved roads. Good schools and churches of many denominations and sects are found in the larger towns.

Antigua is a small island of 108 square miles, approximately 280 miles east and slightly south of Puerto Rico. The northeastern portion is flat, consisting of coral limestone, while the southern parts of the island are rugged and volcanic. Average annual rainfall is 43 in. The population of 35,000, almost entirely of African origin with only a small number of white settlers and landowners, is employed almost exclusively in the production of sugar cane and cotton.

The island of Trinidad, about 10 deg. north of the equator, is the most prosperous British colony of the West Indies. It was discovered by Columbus in 1498 and later colonized by Spain. Roughly square in shape, it is about 50 miles long, north and south, and 40 miles wide. The northern quarter is mountainous, with many peaks reaching 3,000 ft. The middle and southern parts of the island are definitely lower and tend to be rolling, and coastal as well as inland swamps are numerous. The island is very fertile and possesses many natural resources. Agriculture is well developed and almost all types of tropical products are grown. Important sources of revenue are sugar, rum, molasses, cocoa, coconuts, citrus and other tropical fruits. Britain's "Imperial College of Tropical Agriculture" is located on this island. Mineral and oil deposits are quite extensive. The rainy season, which is also the hotter period of the year, extends from May to November, while the remainder of the year is dry and cooler. Precipitation is highly variable in different parts of the island; at Port-of-Spain it averages about 64 in. annually. The total population is approximately 450,000, with Africans and East Indians predominating, supplemented with numerous Chinese, French and Spanish.

St. Lucia, midway between Antigua and Trinidad, has an area of 233 square miles. It is of volcanic structure, very rough and mountainous, but the soil is unusually rich and fertile, and all forms of tropical vegetation thrive. The central high mountainous section receives precipitation in excess of 100 in. per annum, but near the coast rainfall amounts to only 40 to 60 in. The principal article of export is sugar although cocoa, coconuts, copra, lime, oil and spices are also exported.

British Guiana is the only British colony in South America. It has an area of about 89,500 square miles. The country can be divided into three definite belts: the coastal plain, the intermediate area of sand dunes, and the interior mountainous region. The coastal plain is low, narrow and fertile. The elevation of a large portion of it is below high tide, but it is protected from flooding by seawalls built by early Dutch colonists. Conditions are extremely favorable for the production of sugar cane and rice. This small coastal area has been developed for almost 200 years and contains practically the entire population. Rainfall here averages 90 in. per year, and distribution is such that there are two wet and two dry seasons. Humidity is high, averaging 80 percent with but little monthly variation, and daily temperatures range between 75 and 85 deg. Due to the tempering effect of the trade winds, the climate is generally considered agreeable. British Guiana has a population of 340,000, of which over 90 percent are either East Indians or Negroes. There are 2,000 Europeans, with small numbers of Indians and Chinese.

From the foregoing it will be apparent that the initiation of work at these locations required an unusual amount of advance planning. Mobilization of personnel, equipment

Construction camp for American workers at Trinidad. A few months ago this was a dense jungle. Note that the buildings are on concrete stilts to protect against termite infestation and complete screening is provided to keep out insects.

and supplies included the major problem of arranging transportation to the various sites. Initial plans also necessarily included provisions for housing, feeding, medical attention, recreation and other needs of the workers, to a much greater extent than would be required for similar construction in the United States.

Facilities for working forces

The first requirement at each base was the erection of a construction camp to provide the necessary living facilities, hospitalization, etc. In some instances, it was necessary to provide these camp facilities for native labor as well as imported personnel. The plans for these camps have been based upon sanitary surveys conducted by the Medical Corps of the United States Army. The provision of the necessary basic facilities for these construction camps was in itself a problem of some magnitude, as all of these bases, with the exception of that in Bermuda, were constructed at virgin sites. It was necessary to clear trees and brush, drain and fill swamps, build adequate roads and create suitable water supplies before the major construction program could be undertaken. As the sites were opened up it was possible in some cases to develop local supplies of aggregates and of lumber.

The work at all of these stations is being performed by American contractors. Supervisory and key personnel, and practically all skilled workers, are imported from the United States, while most of the common labor is recruited from the native population. All American employees are furnished free transportation to the bases, and are expected to remain for a minimum period of six months. Family quarters have been provided for those key men who desired to take their families with them, and all other American workers are housed at the site of the work, usually in barracks.

Living quarters are made as comfortable as circumstances permit, and in all cases are at least equivalent to quarters available to construction workers in the United States. The Army Engineers knew from past experience that, to work effectively a workman must have good food, clean and sanitary living quarters, and recreation. In the tropical climates, quarters are fully screened and all are constructed on stilts to provide better ventilation and to furnish protection against objectionable animal life. Messing facilities are provided for the men and the average cost for room and board is ten dollars per week. Care is taken to see that well-balanced diets are provided. Full advantage is taken of fruits and other native products in the tropical localities, but adequate quantities of products are imported to insure that employees will have the kinds of food to which they have been accustomed in the United States.

Workers going to the bases are required to pass rigid physical examinations. Particular attention is given to the detection of hernia, weak heart or lungs, high blood pressure, respiratory diseases, varicose veins, venereal diseases, and defective hearing. In addition, all personnel are inoculated against typhoid, tetanus, yellow fever, and typhus, and are vaccinated against smallpox.

Adequate recreational facilities are provided. Each base has a moving picture theater, and most have libraries. Beaches for swimming exist at Bermuda and Jamaica, but at most other localities swimming is forbidden, either because the water is contaminated or because of sharks or other marine life dangerous to man. Cigarettes may be purchased tax-free at the commissaries, where refreshments of various kinds are also available. Air mail service is available at all of these bases.

Employees desiring to move their families to these bases may do so only with the consent of the Base Commander and, with the exception of the key personnel mentioned above, are required to find lodging for their dependents in nearby towns. On some of the islands quarters for families are relatively easy to obtain, while on others it is practically impossible to find suitable accommodations. Rents are relatively high, comparing generally with those in New York City. Hotel accommodations are expensive everywhere; in Jamaica, for example, the average cost is six dollars per day including meals.

It is to be expected that the United States' entry into the war will result in certain changes in the construction program at these bases. The extent to which these changes may affect working conditions is, of course, problematical, but it does not appear that such effects will be markedly different from those that will occur on similar projects in the United States. In any event, it is certain that the loyal cooperation of workmen at these sites will be continued in spite of any hardships that may arise.

AN URGENT PROBLEM FOR 1942

Material Shortages —Redesign and Substitution

Herbert L. Whittemore
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National Bureau of Standards

***Editor's Note**—It is apparent that engineers and contractors are going to be obliged to resort to many expedients because of the shortages of materials to which they have been accustomed. The problem will get worse before it gets better. It is not insoluble, however, as Mr. Whittemore demonstrates. Steel required can be decreased considerably by special methods of design. Plain concrete can be used more widely. Modern developments make timber suitable for quite large structures. In short, careful thought to redesign and substitution can conserve large quantities of critical materials.*

BECAUSE the construction industry is judged by accomplishments and not by words, engineers and contractors were at a disadvantage during the recent period of endless talk about what should or should not be done about threatened shortages of commonly used materials. But when Japan unexpectedly took the initiative last Dec. 7, all of the "logical" explanations of the difficulty or the impossibility of doing a given job suddenly stopped. It was then possible to face the task ahead realistically.

Obviously, if materials are to be scarce, past practices will have to be discarded or modified. Keen, trained minds are needed to evaluate all the possibilities and select the most feasible one, even if it violates experience, precedents and regulatory restrictions. On some of the structures to be built maintenance costs will perhaps be high, but long life is a minor consideration now and, although it is necessary to safeguard life and property, unnecessarily high factors of safety are out. Unusual materials, designs, and methods of fabrication not used in normal times are entirely justified under prevailing conditions.

A successful inventor stated recently that war is a "field-day" for inventors. Their ideas receive careful consideration and, if they appear feasible, are quickly tested and used. Almost any proposal deserves a hearing. From now on our motto is, "It can't be done, but here it is."

If we build of steel

The country has reached its maximum production of steel with existing facilities, and to increase output further presents great difficulties. Because of the enormous tonnage required for armament and ships, the supply available to the construction industry is greatly restricted, and therein is born a problem of considerable magnitude. Moreover, most alloying elements are scarce and necessary for the armament program, so that only mild steel in limited quantities is available for other purposes. The huge deposits of molybdenum in the United States are assurance that there will be no shortage of this alloying element, which is satisfactory for high-strength structural steel, but undoubtedly the more familiar structural alloy steels containing nickel or silicon will be unobtainable for the "duration."

From now on the designer of steel structures will be under the moral obligation, if not the absolute necessity, of using what steel he can get most efficiently; every cubic inch must do its full share in carrying the load. Stresses of 20,000 psi. are allowed by the building codes of many cities; other cities must follow suit. Rolled sections must be selected from the OPM's simplified list of structural steel shapes; this will require careful designing to select the most economical section modulus.

And, at whatever cost of time and mental anguish, the designer must make use of all the available information, both theoretical and experimental, to conserve steel. He should take advantage of continuity in his design—for example, by designing floors and roofs as continuous over supports and by making the horizontal members continuous with the vertical members, i.e. using rigid frames. Recent work on steel rigid frames indicates that the customary radial stiffening of the knee can be decreased, possibly eliminated in many cases. Fabricated members having perforated coverplates may weigh less than members having lattice bars; their use is worth investigating. Obviously "handbook" engineers cannot safely be intrusted with this type of design, which requires experienced men having a background of sound theoretical training.

On account of the scarcity of materials, European countries for years have placed great emphasis on scientific design by theoretical studies, extensive laboratory investigations and the carrying to completion of what many American engineers consider very daring structures. The abundance of our material up to this time made it unnecessary to follow in their footsteps. Now we must emulate some of the precedents they have set.

Although the results may not be available in time to help much, carefully planned investigations of structures should be undertaken without delay to furnish the background for a rational theoretical stress analysis by means of laboratory tests on full-sized members. Too often in the past

elaborate programs of tests have been started in the vague hope that the results would have wide application. Theory unless confirmed by laboratory tests is of doubtful value, and tests that do not increase our understanding of the underlying theory have very limited application. Careful planning of a test program may increase the value of the results a hundred fold. Unlike some of our other defense activities, these investigations will pay large dividends after the war.

Previous to the first World War most of our information on the strength and other properties of large specimens and structural members was obtained in the famous Emery testing machine at Watertown Arsenal. The results of these tests were summarized in our engineering textbooks. Since that time a number of hydraulic testing machines of improved design, capable of applying loads of several million pounds to specimens up to 40 ft. in length, have been installed in university and industrial laboratories. Unfortunately, intensive use has not been made of all these facilities. Only in recent years have instruments and methods been developed for measuring the stress distribution (including two-dimensional stresses) either in the laboratory or in the field on actual structures.

Anyone proposing a change from present practice must realize building officials and other regulatory bodies unavoidably tend to be hidebound by precedent, and lean over backwards to insure safety. No regulatory body is ever in the van of progress. They only follow on reluctant feet, and grudgingly consent to changes long after engineers and architects are convinced that the changes are necessary and desirable.

As one outstanding engineer said, "During this period of stress I have failed to notice that our government has as yet attempted to utilize the available advanced knowledge of engineering."

Special fabrication procedures also offer important opportunities for conserving steel. Everyone knows how greatly the strength of steel can be increased by heat-treatment. Because of the size of structural members, it has not been the practice to heat-treat them, yet this method of increasing the strength of low-alloy steels should not be overlooked. Also no one needs to be reminded that pieces of any desired shape can be cut from plate by the oxyacetylene cutting torch, the use of which has increased enormously. Judicious use of this method of cutting pieces for structures should save some steel.

Fabrication by electric arc welding has increased by leaps and bounds, particularly in the building of ships. The efficiency of a welded joint is much greater than that of a riveted joint and, if the structure is designed for welding, less steel is required, often as much as 20 percent less.

Tubes, although an efficient structural section, have not been used extensively because of the cost of the tubes and the difficulty of making connections. Now tubes formed from strips and welded longitudinally are on the market and should be considered for members subjected to torsional or compressive loads and for flexural members subjected to transverse loads in more than one direction. Joints between tubes and between tubes and plates or rolled sections are readily made by welding, and the resulting structure is very rigid. As for any new product, the structure should be redesigned to take full advantage of the properties of the tubes, including higher working stresses.

The outstanding characteristic of tubular structures is low weight. Their extensive use in airplanes needs no proof, but the time has come for tubular structures to stay on the ground and find a place in buildings and bridges—at first in small structures.

Masonry materials plentiful

As yet no one foresees a shortage of masonry materials—stone, brick, tile, and mortar. It is improbable, however, that they will replace steel except in a few cases. Although there are methods of using them more efficiently, such as in reinforced brickwork, they will not solve the metal shortage problem.

Concrete has wide utility

Years of intensive research have made concrete one of the most widely used engineering materials. Under present conditions it is unfortunate that reinforced concrete has sinews of steel. Nevertheless we must rely more and more on concrete for our structures. To keep the amount of steel for reinforcement as small as possible, so that we may have guns, the following suggestions should be considered carefully:

Make columns and walls either of brickwork or plain concrete. Reinforce them only if necessary.

In flexural members (beams, girders) of reinforced concrete, the greater the effective depth, the less the reinforcement required; a qualification to be noted is that the amount of reinforcement must be sufficient for the diagonal tensile stresses.

Provide continuity of design to decrease the maximum bending moments, as by making the floors and roof continuous over the supports and by making the horizontal members continuous with the vertical members (rigid frame).

Use two-way instead of one-way reinforcement for slabs.

Use hollow "T" or "I" sections, not solid rectangular sections for long spans.

Substitute gravity type buttresses and retaining walls for the reinforced type.

Utilize fixed arches for long-span culverts, roofs and bridges. If large parasitical stresses may be caused by shrinkage, temperature changes or plastic flow, use hinged arches of reinforced concrete.

Instead of flat use vaulted roofs, either barrel or intersecting vault types; they require less concrete and only half the steel. Better still use hemispherical domed roofs, which take only two-thirds the concrete and one-third the steel necessary for a flat roof.

If the dead weight of the members is large compared with the live load, especially if they are supported by flexural members (beams), decrease the dead weight by making the members of light-weight concrete (slag or burned clay aggregate) or by using light-weight fillers of structural clay tile or hollow concrete block.

Use reinforcement having a high bonding value.

The last suggestion is so important at this time that engineers designing concrete structures should have clearly in mind both the advantages and the limitations of bars showing a high value for the bond with concrete. These bars are produced commercially and should be more widely available.

In 1898, Considère pointed out that, other factors being constant, the

width of tensile cracks in reinforced concrete depends upon the texture of the surface of the bars. In 1921, Bach and Graf reported on a more comprehensive investigation of the factors affecting the width of cracks caused by tensile stress. With the same percentage of reinforcement, the width of cracks was less the greater the number of bars, and less also for bars having rough surfaces than for smooth.

Since then both theory and tests have confirmed these conclusions. Posey, Abrams, Wernisch, Gilkey, Menzel, Johnson and Watstein have shown that the nature of the roughness of the bars has a great effect on the bond with concrete. By all means select from the bars available the one having the highest bonding value, which should be at least 50 percent greater than the value for ordinary bars. It can and should be 100 percent greater. By so doing you will need not only less steel for the permissible width of cracks but also for anchorage and lapped splices. If the only purpose of the reinforcement is to minimize cracking due to shrinkage and temperature changes, less steel is required; and if high-strength steel is used much less is required.

If stresses higher than those recommended by accepted authorities are considered, it must be remembered that bars with high bond values have little effect on the deflection of flexural members but that they do decrease the width of cracks. Bars of this kind should be required for all concrete to retain liquids, as in storage tanks and reservoirs. To decrease the width of cracks and thereby leakage and the corrosion of the bars, these structures are usually designed for a stress in the reinforcement of from 8,000 to 12,000 psi. The same result should be obtained by using the most efficient type of bar and considerably higher stresses.

Timber offers great possibilities

From the landing of the Pilgrims to the Civil War wood was our outstanding structural material and the backbone of our material civilization. Although, of recent years, it has gone out of style, wood still shelters three-quarters of us from the weather. Protected from decay, marine borers, and destructive insects, wood structures have an exceedingly long life. So protected, hundreds of well-designed wood bridges, many built more than a century ago, are serving satisfactorily though they have received little attention for long periods.

Much to the amazement of everyone, we learned after the last World War that large wood structures were being built in Europe. Stimulated by this discovery and by a number of important developments, we are again building engineering structures of wood.

Metal connectors, which greatly increase the shearing strength of bolted connections between wood members, have played a major role in extending the use of timber construction. In the past seven years, 18,000 structures have been built with these devices in 44 states. They required 562 million board feet of lumber valued at $11,000,000. Why should anyone struggle for priorities to extend his shop or factory, bridge a river, or erect a water tank, when he can do it himself with local materials and labor?

Laminated arches of seasoned and surfaced boards, bonded with water-resistant glue, have been used in 200 buildings such as gymnasiums, churches and theaters. The first building, erected in 1935, spans 45 ft., the arches following the side walls and roof slope from foundation to ridge. One building has three-hinged arches and spans 120 ft.

Plywood, unlike laminated construction, has adjacent plies at right angles. If bonded with synthetic resin, it is waterproof, and is rapidly finding its place as a structural material.

Rigid frames of wood, consisting of a wood skeleton covered with plywood attached by water-resistant casein glue, are another development available to the engineer or contractor who cannot get his accustomed materials.

Vaulted barrel roofs of wood require less material than flat roofs. They have interesting possibilities, but little has been done to work out the details of design. Apparently this is a case where the engineer must rely on his ability to apply his fundamental engineering training.

Even earth buildings are possible

Small buildings with walls of earth have been erected in this country ever since it was settled. Instructions for making earth walls have long been available and, recently, technical information on the strength, water permeability, and heat transfer of such walls has been published.

Suitable earth for building purposes is available almost everywhere. With little preparation, it is either rammed in about 4-in. layers between forms, which are raised as the wall goes up, or molded into blocks which are laid like masonry units. The walls are not eroded by wind-driven rain if the earth is stabilized either with portland cement or emulsified asphalt.

The inside of the walls may be coated directly with cold-water paint or finished in any of the conventional ways. If the earth is stabilized, the outside of the walls needs no protection from the weather; if not, wide overhanging eaves or a water-resistant coating is desirable in other than arid climates. Earth walls are fire-resistant, and are suitable for shops and dwellings.

Fire resistance

Even the most temporary building can be made reasonably fire resistant at no great increase in cost. Failure to do so may seriously delay our armament program.

To prevent the spread of fire it is essential that large floor areas be subdivided by fire walls or partitions and that stairways and elevator hoistways be enclosed. Fire doors and shutters should also be provided in otherwise adequate fire barriers.

It may be helpful to remember that a partition having wood studs and $\frac{3}{8}$-in. gypsum wallboard on both sides has a fire rating of only 25 min. combustible. (The term "combustible" in these ratings designates constructions having inflammable members, in this case the wood studs.) If the wallboard is $\frac{1}{2}$ in. thick, the rating is 40 min. combustible. Plaster, on the other hand, may have a higher rating, principally because it is thicker. If on both sides of the wood studs there is sanded gypsum plaster $\frac{3}{4}$ in. thick applied on metal lath, the rating is one hour combustible, and if wood-fibered gypsum plaster 1 in. thick, two hours combustible.

It is evident that partitions can be erected at reasonable cost, which will prevent the spread of fire until fire-fighting equipment can arrive.

And as a final thought: He is indeed a confirmed pessimist who does not see that many of today's expedients will be tomorrow's accepted practice.

AN URGENT PROBLEM FOR 1942

Post-War Planning —Public Works

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***Editor's Note**—Destined to assume a vital role in the post-war period, public works has long been recognized as an important cog in our economic machinery. Considerable progress has been made since 1931 when Congress first declared a policy of programming federal public works construction. Today, state and local public works plans, as well as federal activities, are being coordinated in a vast program for national development. The objectives of this program and the steps leading to its adoption are outlined by a man who has played a prominent part in translating a philosophy into practical procedures.*

PLANNING for a post-war public works program is really planning for one aspect of the post-war world. What kind of world that will be, of course, we cannot now know. We do know, however, that the world of today is vastly different from the one we knew no more than two or three years ago. As recently as 1939, it was being said that continued mass unemployment was the central economic problem of the country, but today the problem is one of finding enough men, materials and hours to enable us to double and redouble our national output. Similarly, we can safely assume that the world of tomorrow will be different from that of today.

When victory comes, what problems shall we face then? Some few aspects of that problem, in the light of today's information, can be given rough outline. For example, when victory comes we shall have been exerting our maximum of productive effort. The value of our production may be 100 or 110 billion dollars annually, of which a major portion will have been for our war effort. Will cessation of hostilities be followed by a drop in national output to 80 or 70 or 60 billion dollars, with the corresponding drop in national income? Will the millions of men who have been giving their utmost in our war effort be no longer needed? Shall we experience a faltering economy and a society that is out of adjustment with its potentialities?

Such a nation would not be victorious, regardless of what the military outcome would have been. We must set a goal for ourselves. We must make sure that our manpower and our productive facilities are fully employed to bring about the high level of income of which we now know we are capable. We must plan to balance our national production-consumption budget at a high level with full employment, not at a low level with mass unemployment.

A broad program of building public works must be an important part of our plan. Through public works underdeveloped areas of our country are stimulated toward greater productivity, commerce and industry are facilitated, life and property are made more secure in the city and on the farm, metropolitan civilization is made possible. Through the process of construction, employment is created, industrial production is brought about and the circulation of the income stream is aided. Our public works program will fill a vital role in our total plan to keep our economy functioning at a high level, to direct toward the uses of a world at peace strengths and energies at least equivalent to those now so necessarily directed toward national defense.

The task of making our Nation the land we intend it to be is an enormous one. Our cities are badly down at the heel and need rebuilding, our transportation system requires modernization, much of our population needs to be rehoused, our polluted streams need cleaning up, our fertile lands must be saved from destruction. These are but a few of the things we need to do, of the public works projects for which we must plan.

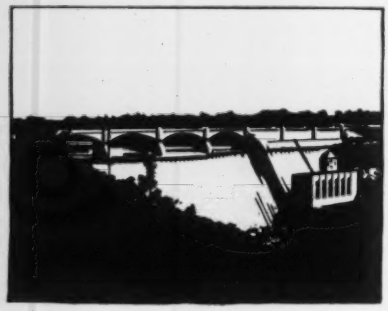
Post-war objectives

There are at least three objectives that might be set for such a program of public construction in the post-war period. They are (1) to further the physical development of the United States so as to bring it closer into accord with our national aspirations; (2) to stimulate and support the Nation's economy through the materials orders and wage payments that are occasioned by the construction process; and (3) to provide opportunities for employment for those who would otherwise not be employed. These objectives are complementary, not exclusive. A program of public construction can be made to achieve all three.

If national development is chosen as the principal objective, the other two goals almost automatically are won. For illustration, the needs of public construction for materials makes heavy demands upon the products of industry. Steel, copper, timber, petroleum products, cement, brick, tile, glass, machinery — all these and many other products are called for in huge quantities. In fact, the industrial processes upon which such a program depends account for a larger share of the value of the final product than does the construction process itself. We can say, therefore, that just as there are many thousands of construction

workmen normally identified with public construction and dependent upon it for their livelihood, there are even more thousands of industrial workers whose normal employment and income are attributable to the demands of public construction upon their productivity. The larger the program the greater is the number of industrial workers called into partnership in the effort.

Moreover, the spread of the activ-



ity generated by the program is not adequately disclosed by the geographic distribution of the construction projects themselves. The manufacture of the materials required ordinarily takes place at many other, perhaps distant, points. A bridge constructed in Texas may mean employment in the steel mills in Gary; a water line built in Virginia may support the job of a foundryman in Birmingham.

However, the converse of this proposition—that if national development is chosen as the primary objective the other aims will also be achieved—is not necessarily true. A program could be planned that would require the employment of many people but it would not necessarily contribute greatly toward the development of the Nation, nor even provide any powerful stimulus to private industry. Also a program might be planned to provide a maximum of industrial stimulation and still fall short of bringing about the best sort of national development.

A program focused upon national development will, in proportion to its magnitude, *keep at their jobs* many of industry's workers. The employment effectiveness of such a program, therefore, is not to be measured by the number of people given new jobs on construction projects, but must take into account the industrial workers who retain their jobs because of the program's need for materials. In fact the objective of such a program, in employment terms, might be thought of as the prevention of unemployment rather than the creation of additional job opportunities.

On the other hand, a program focused upon employment creation will, again in proportion to its magnitude, *make new jobs* on construction operations for men formerly engaged elsewhere. In order to create as much new employment as possible with the funds available it is quite likely that the projects chosen for prosecution will be those making the smallest demands for construction materials; the tendency will probably be to maximize construction-site employment. The men so employed may even be, in part, men who had formerly been engaged in the manufacture of building materials.

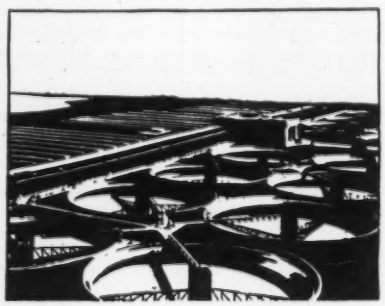
The objective on which focus is sharpest, in both planning and operation, will be of great influence in the determination of administrative policies. Too sharp a focus upon creating employment may lead to policies that will provide less than the maximum of industrial stimulation and less than the best national development. A sharp focus upon industrial stimulation may lead to policies not most conducive to best national development. It is upon national development, therefore, that the planning attention should first be given. We can be assured that a program planned in such terms will yield its full quota of employment and of support to the other areas of our national economy.

Formulating a program

But the task of formulating a program of public works projects that will contribute most to the development of the Nation is no light one. More than fifty federal agencies are involved and thousands of state and local government units. The federal government undertakes public works programs directly, makes grants to assist state and local governments to undertake them, makes loans and guarantees loans to state and local governments and to private parties to aid in the undertaking of others. Properly done, the preparation of a program of all such projects involves the coordination of the program as a whole with the fiscal and budgetary controls of both federal and nonfederal governments. For soundness it must be based upon thorough-going planning, physical, economic and financial.

For that part of the total program that is represented by the construction to be undertaken by the federal government itself, procedures and planning methods have made considerable progress. A statement of policy was first declared by Congress in the Employment Stabilization Act of 1931. That Act provides for the advance planning of public works by the construction agencies of the federal government (as defined in the Act) and by the Federal Employment Stabilization Board that it establishes, and directs that each construction agency of the government shall "prepare a six-year advance plan with estimates showing projects allotted to each year". Also, each construction agency must keep its six-year plan up to date by an annual revision of the plans and estimates for the unexpired years and by annually estimating the plans and estimates for an additional year. Such programs, plans, and estimates for the six-year period are to be submitted annually to the Board and to the director of the Bureau of the Budget.

In August, 1932, the Federal Employment Stabilization Board collected for the first time from the federal construction agencies the six-year programs of public works construction prepared by the agencies under the Act. From 1933 to 1934, when the last appropriation was made for the Stabilization Board (or Office as it was then known), it continued



its activities of serving as a central clearing-house for the federal agencies' programs. In 1936, following the cessation of activities of the Stabilization Office due to lack of funds, the President requested the National Resources Committee to assume the responsibility for the annual revision of the federal six-year program.

Three revisions of the six-year program of public works were made by the National Resources Committee from 1936 to 1938. Each year during this period, consolidated programs based upon the revised programs as submitted by the construction agencies were submitted by the Committee to the President and to the Bureau of the Budget.

Under the terms of the Reorganization Plan No. 1, effective on July 1, 1939, the National Resources Planning Board was created in the Executive Office of the President, and the powers, duties and functions of the Federal Employment Stabilization Office were transferred to it. Also, on Sept. 8, 1939, the President, by Executive Order No. 8248, which defined the responsibilities of the divisions of the Executive Office of the President, directed the National Resources Planning Board to consult with the federal agencies in "developing orderly programs of public works, and to list for the President and the Congress all proposed public works in the order of their relative importance with respect to (1) the greatest good to the greatest number of people, (2) the emergency necessities of the Nation, and (3) the social, economic, and cultural advancement of the people of the United States."

Federal works planning

On June 26, 1940, the President in Executive Order No. 8455 outlined the procedures that were to be followed in this public works planning assignment. Briefly, Executive Order No. 8455 provides for the following:

1. It covers within the provisions of the Employment Stabilization Act all construction agencies of the government not already enumerated by the Act, and groups these agencies into two classes: construction agencies (Class I) that plan or undertake construction directly for the federal government; and (2) construction agencies (Class II) that participate in construction indirectly, or that affect construction activity by means of loans, grants, or other federal financial assistance.

2. Construction agencies (Class I) are required to prepare and keep up to date six-year programs of public works construction and to submit such programs to the Bureau of the Budget in September of each year, at the time they submit their budget estimates.

3. Provision is made for the continuous reporting to the Executive Office of the President by the construction agencies (Class I) of surveys or investigations directed toward the preparation of plans or estimates for construction projects and of the preliminary plans or estimates for the construction projects themselves.

4. Construction agencies (Class II) are required to submit such information on their advance plans and programs as the National Resources Planning Board may request.

5. The director of the Bureau of the Budget and the chairman of the National Resources Planning Board are empowered jointly to make such rules and regulations as may be necessary to make effective the provisions of the Executive Order.

Shortly after the issuance of the Executive Order the first regulation detailing the reporting procedures was promulgated by the director of the Bureau of the Budget and the

chairman of the Board, and the staff work was inaugurated. It is directed toward the development, in cooperation with the construction agencies, of a six-year program of public works coincidental with the preparation of the budget, which can be reported in January to the President and to the Congress at the time of or immediately following the annual budget message. The first year of the six-year program conforms to the President's budget proposals for construction for the fiscal year just ahead; the remaining five years of the program represent a program of further development.

The National Resources Planning Board and the Bureau of the Budget jointly maintain a complete file of reports on surveys and plans for proposed construction projects, as well as information regarding projects under way. The file provides a complete history of each project from its inception to the completion of construction. At the present time the file is particularly rich in projects proposed but not yet approved for prosecution. This part of the file constitutes a reservoir of construction projects as contemplated in the Employment Stabilization Act. On Jan. 1, 1942, this reservoir represented about $3½ billion of proposed projects. The reservoir is constantly replenished by the acession of proposals and is also constantly depleted by the bringing to completion of earlier project proposals.

Correlation in planning

In order to correlate the proposed projects with each other, to eliminate conflicts and to assure maximum coordination, whenever it is appropriate, reports on project proposals by one agency are called to the attention of other agencies that may be affected or concerned by the proposed activity. The agency to which such a report has been referred by the Board is required to report any conflicts with any of its activities then in progress or contemplated, along with its recommendations for suitable adjustment of these conflicts.

The process of planning correlation undertaken by the Board also involves review of the various project proposals by means of two different types of operations: (1) the representatives in Washington of the federal agencies that are concerned with particular types of project proposals, as a group, review the proposals. This type of review proceeds through the technical committees of the Board that deal with the development of certain specific resources, such as water resources, land resources, power development, etc.; (2) through its regional offices the Board also attempts, where practicable, to clear the project proposals with regional, state, and when necessary, local planning agencies. A number of administrative devices have been used to bring about this field correlation: through local "Drainage Basin Committees" organized and maintained by the Board; through regional planning commissions composed of representatives of the federal and state agencies concerned in the area; and through various temporary a real planning and study groups organized for particular jobs.

State and local planning

The problem of establishing a program of state and local government projects is most complex. Properly speaking, such a program should not be formulated in Washington at all but should consist of many programs established by the states and cities themselves. Most appropriately, the federal government's interest should be focused on obtaining information as to what was

in those many programs rather than upon the task of making them itself. This method was developed, tested and demonstrated in a nation-wide series of "demonstration" studies carried on during several years. Today more than 260 cities and towns, 70 counties and 38 states have already completed or in process of establishing long-term public works programs.

A plan for planning

The programming method sponsored by the Board involves:

Tentative Project Proposals — Various planning and operating agencies prepare proposals of needed projects and improvements together with supporting data, cost estimates, and statements of the relation of the projects to a general plan of development. Non-governmental organizations and citizens also, upon occasion, propose additional projects. The proposals are then arranged in some order of relative importance, or priority.

The Financial Plan — The responsible financial officer or bureau prepares analyses of the financial resources, including a study of revenues and expenditures, of the effect of additional expenditures upon the tax and financial structure, and of related economic factors. Through a study of past financial data and present and probable future trends, estimates are made of funds to be available for public improvements over the period of the program.

The Program Preparation — A central authority or committee reviews and analyzes the financial analysis and tentative project proposals, and prepares a program for a definite period, based upon the priorities assigned to projects and upon financial considerations. The schedule for the first year of the program is recommended as a capital budget for the immediate year to follow.

Governing Body Consideration — The governing body reviews the program, and accepts or revises the budget message or report which accompanies the program.

Public Acceptance — Public hearings may be held during the preparation of the program, or the public may be otherwise kept informed throughout the operation. All major works proposals and suggested financial arrangements are fully explained to the public prior to adoption of the program.

The proposed improvements should be evaluated in relation to plans for the future development of the area. Factors which are of importance in this respect are the community's location, area and population, rate of growth, and economic, industrial and social resources. Also, the nature of the facilities and services already in existence will affect the planning of improvements. The findings and recommendations of planning organizations are important in any programming operation. Programs should be prepared, wherever possible, with reference to basic city plans.

In the analysis of financial resources, due consideration must be given to tax limitations, statutory requirements such as bonding limits, existing governmental fiscal policies, and the attitude of taxpayers and their organizations.

The objective of long-range programming is the orderly provision for public works needs for several years in advance, but provision for annual review, revision, and extension must be included in the programming procedure. When the program is annually reviewed, new projects for which the need has developed during the year can be added, while projects superseded, or for which the need has declined, can be removed, and others can be shifted within the program. An additional year is added to replace the year just completed, and the revised list of projects is scheduled over the full program period. The schedule for the first year of the new program can again be recommended as the capital budget for the following year. The repetition of this operation every year results in a carefully conceived long-term program always available for use.

Until 1940, operations in state and local programming of public works were in the "laboratory" stages. The "pilot plant" stage was reached during 1940 and 1941 when the lessons learned in the demonstration studies were applied in assisting states to program their public works. The necessity for developing a public works program for the post-defense period has caused attention to be directed in 1941 to the establishment of a full scale operation.

Work reserve established

To implement this operation, the Federal Works Agency, with the National Resources Planning Board as co-sponsor, established the Public Work Reserve, operating through the Work Projects Administration. Among the objectives of this operation are: (1) To accumulate an immediate listing of needed public projects as a reserve to absorb post-defense or emergency unemployment; and (2) To provide assistance to state and local governmental units in assembling data and in preparing long-range public improvement programs based upon actual need.

If public works programming is well done, at both the federal and non-Federal levels of government, the adjustment of national policy so as to achieve the aim of employment stabilization will be immeasurably simplified. When fully developed, the programming operation will yield information at all times as to the extent of the Nation's public works activity to be anticipated over a period of years in the future. Federal policies for expansion or contraction might then be determined in that light, to the end that true employment stabilization might be achieved.

For example, if examination of the program disclosed that the total amount of public works construction would be inadequate to fill its rightful place in our national economy, the federal policy might be modified in any one or more of several directions to bring about its enlargement. Federal budgetary expenditures might be increased, the extent of grants-in-aid for non-federal construction might be enlarged, or the scope of loans or loan guaranties might be widened. Conversely, a retraction along any of these lines would bring about curtailment if curtailment seemed most desirable in the interest of a healthy economy.

A shelf of projects

To approach closer to the goal of adequate preparation for the post-war period, at least with a shelf of public works projects, the Board made certain recommendations in its report last year which culminated in the bill now before Congress to amend the Employment Stabilization Act. If this proposed amendment should be enacted into law, not only would public works programming be greatly facilitated, through assistance to the states and cities for that purpose, but funds would also be available for another essential step in full preparation—the making of actual designs and specifications. An adequate program for five or six years in advance, made up of completely planned projects known to be of the maximum usefulness in developing the Nation, with an appropriate number fully designed and ready for construction, would put us in a position to realize the true potentialities of a public works program in our post-war plan.

HEADLINE PROJECTS OF 1941

Progress during the year on the nation's most well-known engineering and construction projects is recorded in the following pages. Engineering News-Record is indebted to the many engineers and officials who provided the data for the projects mentioned.

BRIDGES • WATER SUPPLY • SEWAGE DISPOSAL • BUILDINGS
POWER • IRRIGATION • FLOOD CONTROL • TRANSPORTATION

Herbert Foster photo

Rainbow Bridge, longest hingeless arch span in the world, 950 ft., was completed Nov. 1. Spanning the Niagara River a short distance downstream from the Falls, the crossing provides two 22-ft. roadways separated by a 4-ft. mall.

BRIDGES

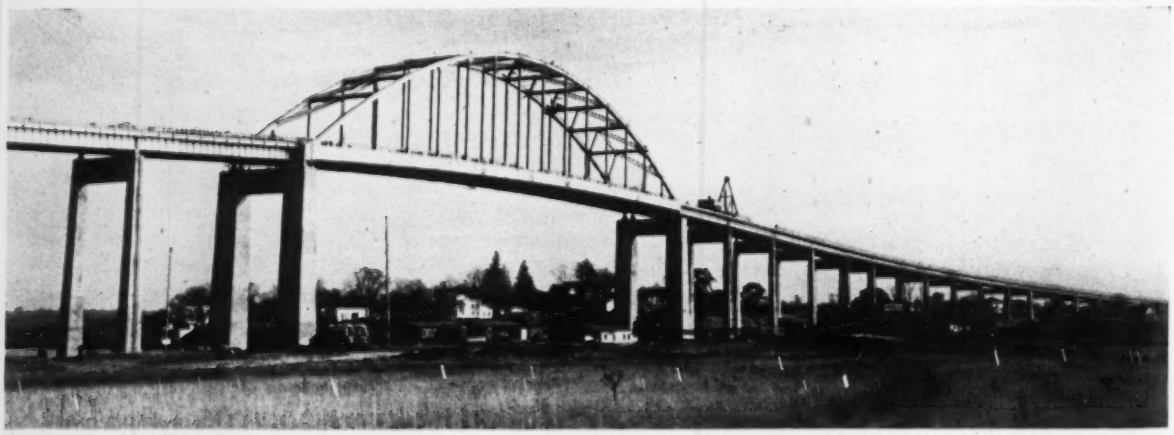
TACOMA NARROWS BRIDGE—Since removal early in 1941 of a part of the wreckage, mainly suspenders and approach spans, the cables and towers of the Tacoma Narrows Bridge, which collapsed in November, 1940, have remained standing awaiting further developments. Three boards of engineers have studied the failure; namely, a three-man board representing the Federal Works Administration, a five-man board representing the insurance companies and a three-man board representing the Washington Toll Bridge Authority. Reports of the first two have been made public; that of the third has not. Meantime, there has been settlement out of court of the impending suit between insurance companies and the bridge authority under terms providing for payment of a $4,000,000 indemnity. This clears the way for action on a new design and attention has been focused on methods of financing as well as on the acceptable type of the new structure. The increasing importance to the Bremerton Navy Yard of having a direct rail connection supports the desire of the Navy for a bridge that will take rail traffic. Any such structure, presumably of cantilever or continuous truss span, would require construction of at least one additional pier in mid-channel, which would make the requirements for the two main channel spans 1,400 ft. each.

PIT RIVER BRIDGE—This record structure, 500 ft. above streambed and 3,588 ft. long, which will carry the relocated main line of the Southern Pacific R.R. across an arm of Shasta Dam Reservoir, is scheduled for completion Mar. 1, 1942. The first train to cross the bridge took a load of steel over on Nov. 25, but this trip was made at a time suited to operations on the upper or highway deck where concrete pouring is under way. Work on the upper deck, a separate contract, is to be speeded by use of a canvas tent under which paving can be continued during the winter. Only by this expedient could completion of the roadway paving be expected by Mar. 1, which is some three months ahead of the contracted schedule. At the end of the year, long steel girders in the highway approach to the bridge at the north end, were being placed. Concrete paving was being advanced from the south end, in 80-ft. sections, alternately working on opposite sides of the centerline.

DUBUQUE BRIDGE—The highway bridge under construction across the Mississippi River from Dubuque, Iowa, to East Dubuque, Ill., is of steel superstructure supported on reinforced-concrete substructure with concrete floor and sidewalk. The project will provide a 24-ft.-wide roadway and a 5-ft.-wide sidewalk. The total length is 7,000 ft. and the distance between abutments is 5,760 ft. Across the main part of the river there is a 1,539-ft.-long, continu-

The new bridge carrying Du Pont highway over the Chesapeake and Delaware Canal at St. Georges, Del., is a 540-ft.-span tied arch. It is unusual in that the bending moments caused by partial live loads are resisted principally by the tension tie rather than the compression rib.

U. S. Engineer photo



ous, through-truss, tied-arch cantilever span of novel design, with the central span 845 ft. and side spans 347 ft. The remainder of the superstructure is of deck girder and deck beam spans varying in lengths from 44 to 181 ft. The construction program contemplates completion in early fall of 1942. Of the 44 substructure units, 40 were complete at the end of 1941 and work is proceeding on the other four. Steel fabrication is well advanced on the entire superstructure and erection will begin soon. Contracts are to be let next spring for the entrance plaza at each end of the crossing. The Iowa State Highway Commission and the Illinois Division of Highways are participating with the City of Dubuque Bridge Commission in providing funds for construction. The total investment is about $3,600,000.

STATE ST. BRIDGE, CHICAGO—The two piers, straddling the subway tubes, for the State St. double-leaf bascule bridge over the Chicago River at Chicago are about finished, but construction of the superstructure, for which contract was awarded last May 16, is delayed by priority difficulties. Priorities were requested July 15 and again on Oct. 27, and, according to recent developments, soon may be granted. Some fabrication has been done but material for vital parts has not been available. The bridge will carry two 36-ft. roadways, separated by a 5-ft. center curb, and two 11-ft. sidewalks. The span between trunnions is 245 ft. Each leaf will weigh 4,200 tons. The foundation contract includes dock walls yet to be built. Contracts for the approach and viaduct across the railroad yards at the north end have not yet been awarded.

KENTUCKY RIVER BRIDGE—The Kentucky State Highway Department has under construction a bridge over the Kentucky River at Cleveland, Ky., which will be the highest highway bridge east of the Mississippi. The general design is a three-span, continuous, deck-truss structure with a 448-ft.-long center span and 320-ft. side spans. The $900,000 crossing will be 250 ft. above normal pool level of the river and the tallest piers will have a height of 200 ft. A 26-ft. clear roadway and two 3-ft. sidewalks will be provided when the structure is completed. The substructure work is under way, a contract has been awarded for the superstructure, and bids will be received soon for constructing the roadway.

THAMES RIVER BRIDGE, NEW LONDON—Contract for construction of a high-level toll bridge over the Thames River estuary at New London, Conn., was let in January, 1941. The bridge will have a total length of 5,890 ft., made up of deck girders and trusses on the approach spans and a cantilever truss having a main span of 540 ft. with anchor arms each 352½ ft. long. The clear height is 137½ ft. above mean low water in the channel. Foundations for the main river piers go from 135 to 155 ft. below low water. Construction of the approach span piers has been completed, construction of the main river piers is well advanced, and erection of steel on the approaches is under way. The bridge is scheduled for completion on Nov. 1, 1942.

CONNECTICUT RIVER BRIDGE, HARTFORD—Construction of a new bridge over the Connecticut River at Hartford was begun in September, 1940, to relieve congestion on the existing bridges and as part of the Wilbur Cross Parkway across Connecticut. The bridge will have a total length of 3,950 ft., made up of deck plate girder spans carried on concrte piers, the main river crossing being made up of a 270-300-270-ft. continuous girder unit. Construction of the piers was completed during the year and erection of steel had progressed to the river span at the west end when, on Dec. 4, what is believed to have been failure of falsework supporting the completed section of the first 270-ft. span resulted in the collapse of that steelwork. This accident is expected to delay completion of the bridge from two to four months. Completion was originally scheduled for July 1, 1942.

PEORIA, ILL., BRIDGE—To provide a 26-ft. wide roadway and two 2½-ft.-wide safety walks, the highway bridge under construction over the Illinois River at Peoria, Ill., is expected to be completed in 1943. The piers for the $2,000,000 crossing are almost complete and erection of steel is to start early this year. The 4,745-ft. long structure includes a 3-span continuous through truss unit over the main channel, while the remainder will be made up of 3-span continuous deck trusses, and continuous steel deck girder and I-beam units. The Illinois Division of Highways is doing the work.

Leo Witt photo

July 4 the new Main St. highway bridge across the St. Johns River at Jacksonville, Fla., was opened to traffic. The 350-ft. lift span is flanked by towers 200 ft. high.

Westinghouse photo

Rolled sections were used for the members of the single-track Kansas City Southern R.R. bridge over the Neches River at Beaumont, Tex. Lift span is 245 ft. long.

Chicago Aerial Survey photo

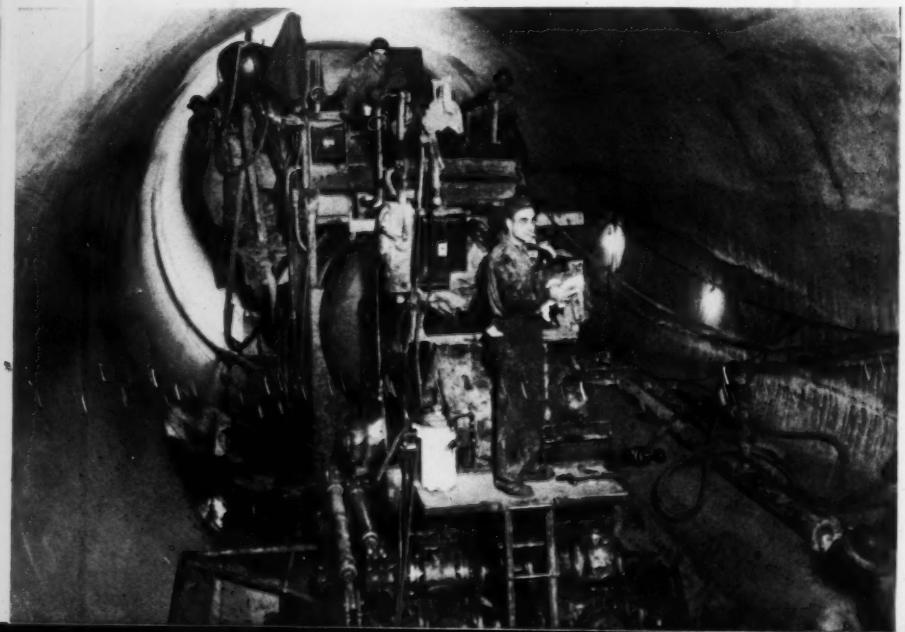
Big water filtration plant in Chicago's South District, at 79th St. and the Lake, is first step in city's plan to treat entire Lake Michigan supply.

WATER SUPPLY

BOSTON—The entire Quabbin Reservoir project including Quabbin Aqueduct and all other works for the development of the new Ware-Swift supply is practically completed. However, installation of water wheels for the development of electric power from the water required to be released from the reservoir and from the water drawn through the aqueduct to Wachusett Reservoir has been delayed. Very little water was stored during the past year of drought; storage as of December reached a total of 80 billion gallons and the water depth at the main dam is 91 ft. The total capacity is 415 billion gallons with the final water depth at 150 ft. The new pressure aqueduct from the Wachusett Aqueduct terminal chamber to a shaft at the western border of the District has been completed including all equipment and appurtenances for controlling the flow. A contract is now being prepared for two additional shafts required to extend this pressure aqueduct by a tunnel about 5½ miles long to Chestnut Hill.

CHICAGO—The South District water filtration plant and related structures are now about 55 percent complete. Of the total estimated cost of $23,800,000, about $13,500,000 has been spent or obligated. Completed work includes the breakwater, cofferdam, connecting tunnels, park beach and approach fill and the concrete substructure for the main plant. In the substructure are the intake basin, raw water conduit, mixing and settling basins, filter beds and reservoirs in which the lake water will be processed. In addition, a considerable amount of mechanical equipment such as low-lift pumps, motors, sluice gates, valves, cast-iron pipe, venturi meters, etc., has been purchased and is now about 60 percent in place. Backfilling of sand and clay around the substructure is progressing rapidly. The structural steel framework for the low-lift pumping station and the filter and administration buildings is under contract and now being fabricated. Bids for the general contract for these superstructures have been opened and it is expected that this contract will be signed at an early date. Design drawings for the chemical building, filter equipment, chemical equipment and the remainder of the mechanical work will be completed shortly, and the entire project should be under contract by February, 1942. The plant is scheduled for completion early in 1943.

Concrete lining of the 85-mi. long tunnel of New York City's Delaware Aqueduct supply is more than 75 percent complete.



DELAWARE AQUEDUCT—Excavation of the 85-mile-long pressure tunnel of the new Delaware Water Supply System for New York City lacks less than half a mile of completion. Concrete lining is underway or completed on all eleven contracts and is more than 75 percent complete for the entire length. Surface and control works along the tunnel are more than half complete. The concrete cutoff wall at Merriman Dam has been completed and some of the rolled fill placed in the cutoff trench though major earthmoving operations have been held over until 1942. The exploratory caissons at the Neversink Dam site, in the second stage of the Delaware development, have been completed and considerable earth moved for rolled-fill cofferdam construction. Completion of the first stage of the project is scheduled for 1944, though the section of the aqueduct leading from the city to the Kensico Reservoir will be available for emergency use next summer. The start of 1942 finds the reservoirs of the present New York City water supply system only one-third full and the city faced with a definite water shortage if winter and spring moisture on the watershed is not above normal.

PHILADELPHIA — An $18,000,000 improvement project started in 1940 is proceeding according to schedule of design but part may have to be revised because of material shortages, particularly in units where steel plate is required. The program includes reconstruction and modernization of present treatment facilities, rehabilitation of pumping equipment and improvement of the distribution system.

OKLAHOMA CITY—Financed with funds from a $7,000,000 bond issue, extensive waterworks improvements are under way at Oklahoma City. A new reservoir to hold a four-year supply is to be built at a cost of over $4,000,000. A 16-mgd. addition to the city's filter plant and a new pumping station will cost $1,000,000, and about the same amount is to be used for over 30 miles of new mains. Since two lettings failed to secure a satisfactory bid, the city is building the reservoir with its own forces. The reservoir calls for an earthfill dam containing 4,000,000 cu. yd.

SEWAGE DISPOSAL

BOSTON—The Massachusetts Legislature of 1941 enacted a bill providing for a $15,000,000 construction program, including a treatment plant, force mains, marginal conduits, and relief sewers. General designs have been prepared but construction shall not be undertaken unless at least 25 percent of the cost is made available from federal funds. Pending receipt of such aid, however, there is a provision in the legislation that provides for the detailed design of this program. The work is to be done under the jurisdiction of the Metropolitan District Water Supply Commission now in existence, which commission is supplemented by the inclusion of the director and chief engineer of the sewerage division of the Metropolitan District Commission and the director and chief sanitary engineer of the department of public health.

PHILADELPHIA—Since the withdrawal of the Philadelphia Authority, created to finance and build sewage disposal facilities, two efforts have been made by the city for the establishment of a sewer rental as a basis of financing the project. The Supreme Court of Pennsylvania has invalidated both proposed methods. Two avenues of approach to the problem remain open: (1) an application has been made to the Defense Public Works authorities for a grant of $42,300,000 of federal funds, upon which no action has as yet been taken; and (2) with the improvement of the financial status of the city it becomes possible to undertake some work in 1942 with a limited amount of funds.

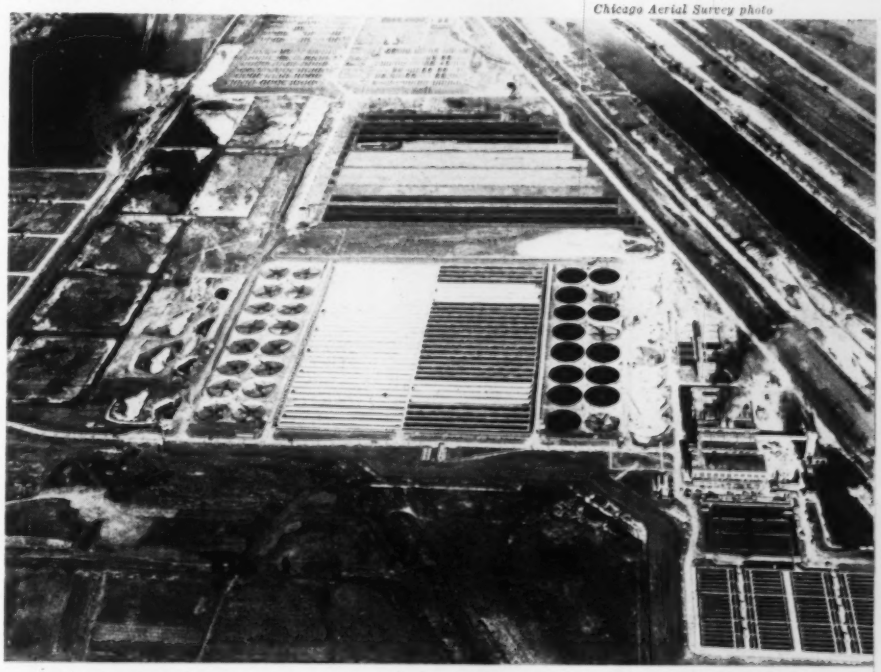
NEW YORK CITY—Progress has continued in the development of the comprehensive sewage treatment program of the city. Extension of the Coney Island works, from a rated capacity of 35 mgd. to 70 mgd., is substantially complete; additional flows, formerly going to the Paerdegat Basin to the extent of about 30 mgd., were diverted to this plant in June. The provisions for secondary treatment at the 40-mgd. Bowery Bay plant by the activated sludge process, is approaching completion and these works should be placed in operation early in the year. A 1.5-mgd. plant to serve City and Harts Islands is also substantially completed. The 65-mgd. activated sludge plant at Jamaica is now about 60 percent complete, with all contracts awarded. Contracts for the settling and aeration tanks and sludge digestion tanks at the 60-mgd. activated sludge plant at 26th Ward, have been awarded. The design program is being continued on new works, which include the Owls Head, Newtown Creek, Hunts Point, Rockaway, Upper West Side of Manhattan and Port Richmond projects.

LOS ANGELES—Conditions during the year have not favored advance of the large sewage disposal project recommended by a board of consulting engineers, which was much in the limelight a year ago. Pending further developments in the matter of financing a comprehensive program for future sewerage development, the Los Angeles city engineer proposes and recommends "a modified general sewage project including the installation at Hyperion of a partial sewage treatment plant and an additional submarine outfall sewer." With this goes a program for repair and ventilation of the existing outfall sewers. These undertakings are estimated to cost a total of $6,000,000. Other sewage projects are estimated at $400,000 and $115,000 respectively. Urgent need for relief from the present situation is indicated by the fact that sewage contamination of seawater along the bathing beaches has been so serious that the quarantine of numerous beaches before next summer has been suggested in some quarters.

CHICAGO SANITARY DISTRICT—Despite difficulties in obtaining some materials, the Sanitary District of Chicago in 1941 was able to complete work amounting to $1,100,000, including a fertilizer loading building, conveyor tunnels, sewer connections, furnace alterations, and piping and electrical work. Two 375-cfs. sewage pumps and a 100,000-cfm. turboblower have been delivered and are being installed. Satisfactory progress has been made on 16 final settling tanks, 126 ft. diameter, to increase the average capacity of the Southwest Works from 400 to 500 mgd. Contracts totaling $5,294,000, covering additions to the Southwest Works have been awarded. Some progress has been made on certain of these contracts, but others have been delayed.

Chicago's Southwest activated sludge plant is being doubled in size as final step in complete treatment of that city's sewage.

Chicago Aerial Survey photo



The 65-mgd. activated sludge plant (below) at Jamaica, N. Y., is being built by New York City and is about 60 percent complete.

McLaughlin Air Service photo

POWER, IRRIGATION AND FLOOD CONTROL

CENTRAL VALLEY PROJECT—On all divisions of the Central Valley Project in California, the U. S. Bureau of Reclamation has carried work forward during the year. By the end of 1941 a total of $107,950,000 had been made available on this project and contracts totaling nearly $100,000,000 had been completed or were under way with some 5,000 workers employed. Expenditure during the year for wages was $11,725,313.

Railroad Relocation—The 30 mi. of new main line for the Southern Pacific R.R. is expected to be ready for train operation about Mar. 1, 1942. Grading has been completed on the 15 miles of relocated Highway No. 99 and work on most of the relocated railroad is finished; still uncompleted are the Pit River Bridge, signal systems, fuel depots, etc.

Shasta Dam—Some 2,000,000 cu. yd. of concrete placed during 1941 brought the yardage in the dam at the end of the year to about 2,500,000, while the total required is 6,000,000 cu. yd. Final height of the dam was officially established at 602 ft. after completing the lowest excavation in the streambed, which was made following the third diversion of the river. This diversion put streamflow over a row of low concrete blocks next to the west abutment. Early in December the river rose enough to overtop the cofferdams and flood out work in the low-level spillway area for the winter season. Installation of generating machinery in the powerhouse has begun. Two of the 75,000-kw. generators have been completed and are stored at Boulder Dam; three more are on order. Penstock fabrication is under way; preliminary surveys for transmission lines from Shasta to Antioch have been completed.

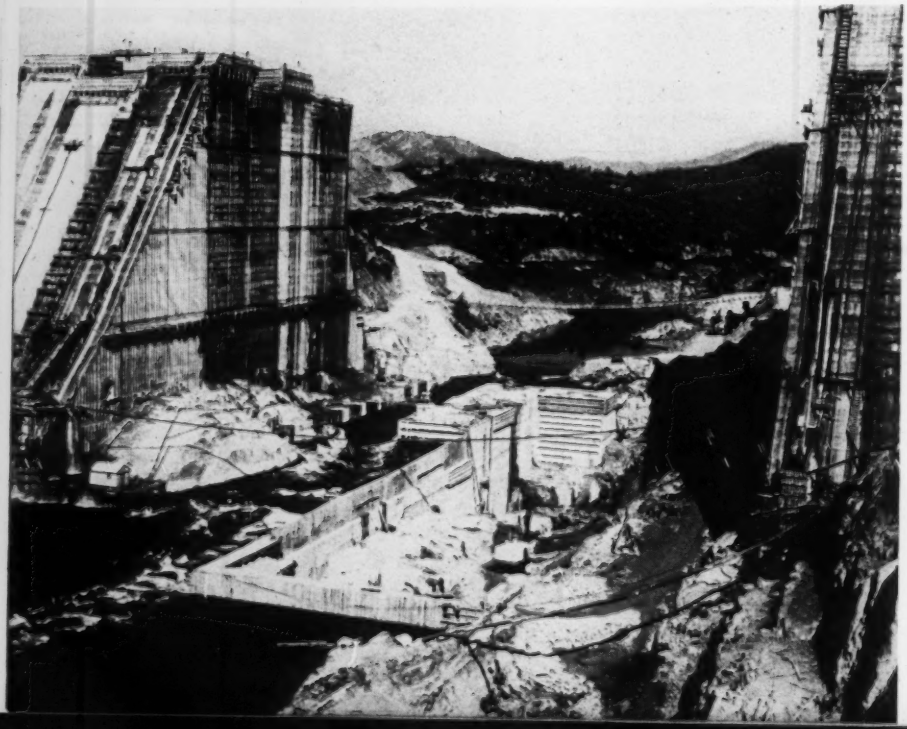
Keswick Dam—Contract was awarded in August for this structure, 9 mi. downstream from Shasta Dam where a concrete dam of gravity section 125 ft. high and 800 ft. long on the crest will develop an afterbay justifying installation of a 75,000-kw. power plant and will aid in regulating streamflow below the Shasta power plant. By the end of the year, excavation for the left abutment and spillway section had been completed; concrete placement had been under way since November.

Delta Division—During the year the Contra Costa Canal, 46 mi. in length, was completed to the 29-mi. point. Construction was under way on an additional 8½-mi. section and agricultural, domestic and industrial water deliveries were being made in the vicinity of Antioch and Pittsburg. Engineering studies including soil examination, surveys and other preliminary work were continued on the Delta Cross channel and the Delta-Mendota Canal, which will convey Sacramento River water into the San Joaquin Valley.

Friant Division—By the end of the year, Friant Dam was practically complete with almost all of the 2,200,000 cu. yd. of concrete in place. Spillway gates and control valves for the irrigation canals remain as part of the future work. In March the river was diverted from a temporary canal on the left bank to temporary conduits in the base of the dam; in November, when ponding began, the river was turned through the four permanent outlets. Contraction joint grouting began late in the year. Construction is under way on the Madera Canal and excavation is complete for the first 8 mi. Canal lining operations began in December. Bids were received late in the year for the construction of the first 5½-mile section of the Friant-Kern Canal, but were rejected because of the war.

Some 2,500,000 cu. yd. of concrete are in place for Shasta Dam on the Sacramento River in California. With dam's final height of 602 ft. concrete will total 6,000,000 cu. yd.

Bureau of Reclamation Photo



DAVIS DAM—Preliminary work during the year has paved the way for construction to start early in 1942 on the Bureau of Reclamation's Davis Dam project (formerly Bullshead Dam) comprising the dam, a rolled earth-and-rock-fill structure to contain some 3,500,000 cu. yd., and a power plant with an ultimate capacity of 225,000 kw. Davis Dam site is located on the Colorado River 67 mi. downstream from Boulder Dam and 80 mi. upstream from Parker Dam. The height is to be 140 ft. above river bed, which will create a reservoir capacity of 1,600,000 acre-ft. This storage is to be used for regulation of the river below Boulder Dam (and hence to increase the efficiency of the Boulder power plant) and to provide additional power and flood control.

MUD MOUNTAIN DAM—After changing the plans calling for an earthfill, Mud Mountain Dam on the White River in Washington was completed Dec. 1 as a rockfill shell with rolled-earth core, carried to record height of 425 ft. Completion was speeded by the unprecedented methods of (1) putting the material for the rolled-fill core through a drying process, making use of oil-fired, rotary kilns and (2) keeping out rain water during storms with an enormous canvas tent hung over the dam in the narrow gorge. The 23-ft. diversion tunnel and the 9-ft. sluiceway were completed several months ahead of the dam itself. The spillway was practically finished by the end of the year and there remained to be placed only a few sections of the concrete lining adjacent to the dam. No flood control is to be effected this winter since it will be necessary to install penstocks, control valves and a valve house in the 23-ft. diversion tunnel before any flood water could be stored. It is expected that the project as a whole will be completed about Aug. 30, 1942.

GRAND COULEE DAM—Some 60,000 cu. yd. of concrete placed in Grand Coulee Dam during the year brought the total in the dam and appurtenant structures to about 10,500,000 cu. yd. This completed the four elevator towers, the bridge of eleven arches over the spillway and the remainder of the training walls. Also, the eleven spillway drum gates were completed and the contractor's construction trestle was removed from the downstream face of the dam except on the extreme east end, where this trestle will be used for construction of the east powerhouse. This additional work, to cost about $4,000,000, is covered in a contract awarded to Consolidated Builders late in the year; its completion will require until September, 1943. Two 12,500-kw. units in the west powerhouse began to supply energy to the Bonneville transmission line in March and early in October the first 108,000-kw. generator was placed in service. More of the latter are to follow at intervals until a total of nine are in the west powerhouse. In the reservoir area, relocation of state highways and the Great Northern R.R. were completed and work was in progress on 13 mi. of relocated county roads. Clear-

ing operations were completed, channel improvements carried out and an extensive migratory fish control program with three hatcheries was under way.

BONNEVILLE DAM—During 1941 construction of the northerly extension of the powerhouse on Bradford Island, in which to house Units 7 to 10 inclusive, was continued behind the protection of a deep cofferdam wall along the north side of the intake channel. When this addition is completed, the powerhouse will be ready for all of the units to be installed in this plant. During the year, also, installation of Units 5 and 6 was completed; No. 5 went into operation in September and No. 6 was ready for service by the end of the year. The manufacture of four 74,000-hp. turbines and four 60,000-kw. generators for Units 7 to 10 inclusive is in progress. These units are to be installed as they are completed, the last of them being scheduled for delivery in December, 1943.

WHITE AND ARKANSAS BASINS FLOOD-CONTROL—Continued advancement was made by the U. S. Engineers on the several projects being built to control floods in the White and Arkansas Rivers and their tributaries.

Norfork Dam—Under construction on North Fork of the White River in Arkansas as a multi-purpose project for hydro power, flood control, conservation, and recreation, Norfork Dam was about 18 percent complete on the first of the year. Roughly 60,000 cu. yd. of concrete have been placed since pouring started on Oct. 10. Norfork Dam will contain about 1,500,000 cu. yd. of concrete and will be the sixth largest dam in the country at completion which is expected in the summer of 1944. It will cost $27,500,000.

Work was started this month on clearing 1,100 acres for the permanent pool and on an addition to the government village at Mountain Home, Ark., near the Norfork Dam site. An additional 22,000 acres will be cleared before the project is completed.

Clearwater Dam—The outlet works for the Clearwater project, being carried out for flood control, conservation, and recreation, on the Black River in Wayne and Reynolds counties, Mo., were practically complete at the beginning of the new year, while construction of the earthfill embankment and excavation for the spillway were 10 percent complete. The contractor had removed 450,000 cu. yd. of material from the spillway area or about 25 percent of the estimated total. The excavation for the spillway will be about 150 ft. deep through a hill about 1,600 ft. long. The spillway will be constructed under a subsequent contract. Clearing of about 500 acres of the Clearwater reservoir area also was started this month with about 1,500 additional acres to be cleared.

Nimrod Dam—A completed project, Nimrod Dam on Fourche La Fave River in Perry County, Ark., was built for flood control, conservation, and recreation. However, penstocks are to be added for future installation of electric power generating equipment. Clearing of the permanent pool area of about 4,600 acres is to be completed in about a month.

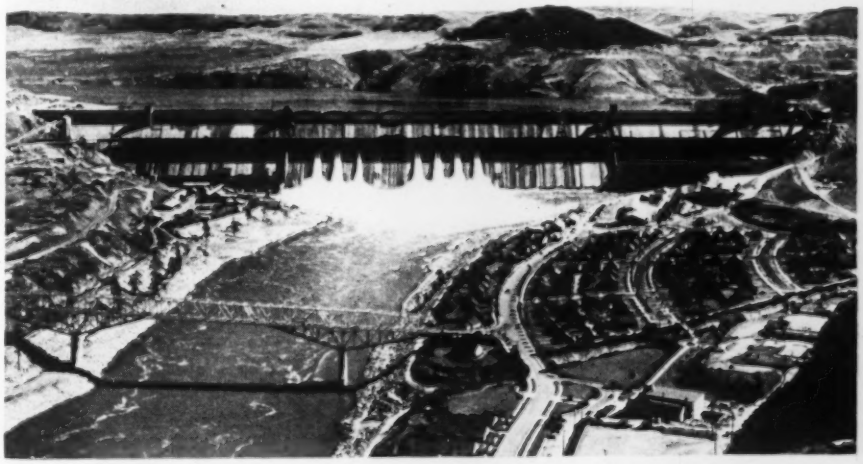
John Martin Dam—Formerly known as

U. S. Engineers Photo

Looking north along axis of Norfork Dam (above) with North Fork River in foreground, concrete plant in background, and contractor's building at left.

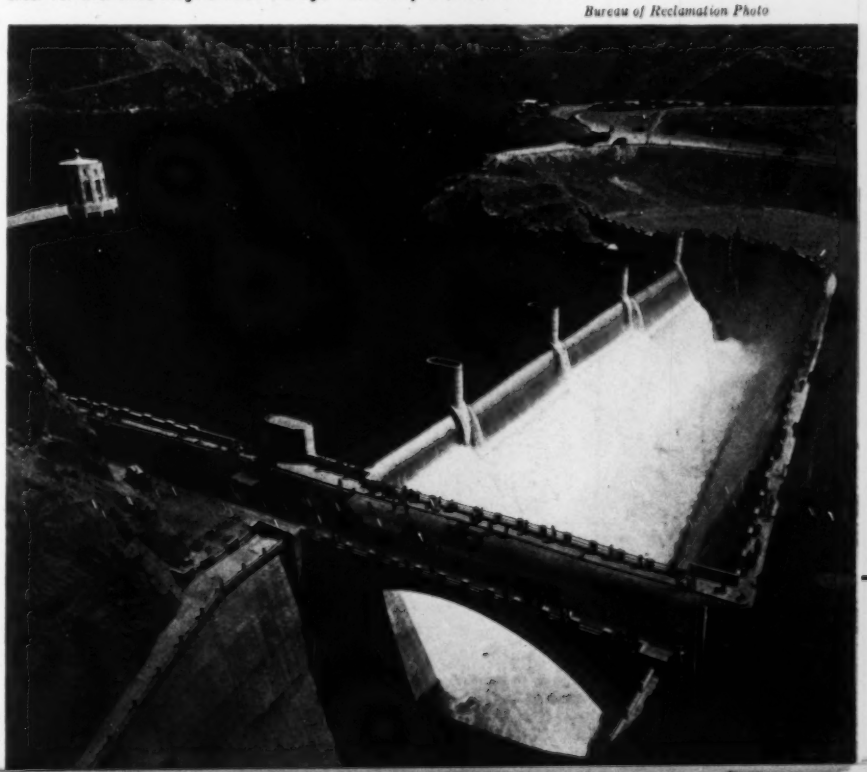
Two 12,500-kw. units at Grand Coulee (below) began to supply power to the Bonneville transmission system in March and in October the first 108,000-kw. unit went into operation.

Bureau of Reclamation Photo



Lake Mead, 115-mile long lake back of Boulder Dam (below), rose above dam's spillway crest for first time Aug. 6 when storage was nearly 31,000,000 acre-ft.

Bureau of Reclamation Photo



Caddoa Dam, the John Martin reservoir project is on the Upper Arkansas in southeastern Colorado 58 miles west of the Colorado-Kansas line. The job, one of the principal projects in the extensive flood control and stream regulation undertaken by the U. S. Engineers, will reduce maximum flow at the site to 10,000 cfs. As the year ended the 1,174-ft. long concrete overflow section was 65 percent complete, and earthfill for the embankment and wing dams, which makes the project's overall length 14,000 ft., was 45 percent ended.

Fort Supply Dam—Located in Woodward County, Okla., on Wolf Creek, a tributary of the North Canadian River, the Fort Supply project is practically complete. The work, which is for flood control, has been under way since 1938 and is costing over $5,000,000.

Great Salt Plains Dam—A flood-control project being carried out by the U. S. Engineers near Cherokee, Okla., the Great Salt Plains Dam and reservoir project is now practically completed. The dam is 61 ft. high.

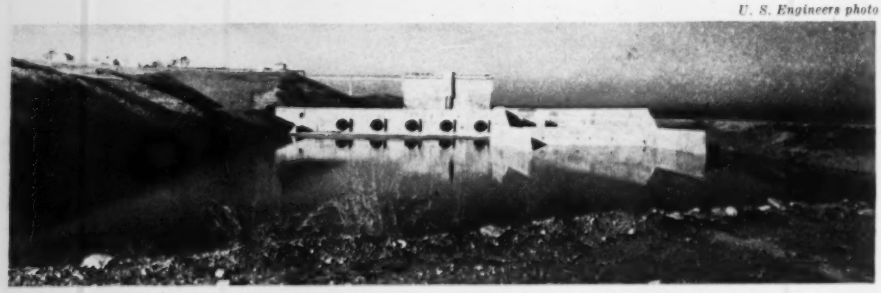
Canton Dam—Located on the North Canadian River in Oklahoma, Canton Dam is an earthfill 3,700 ft. long and 65 ft. high. The project, for flood control, was about half completed at the year's end.

Blue Mountain Dam—Construction of the outlet works of the Blue Mountain project, which is for flood control, conservation, and recreation, on the Petit Jean River in Yell County, Ark., was about 70 percent complete Jan. 1. The contract for construction of the earthfill embankment and concrete spillway was about 26 percent complete, the embankment itself being 35 percent complete.

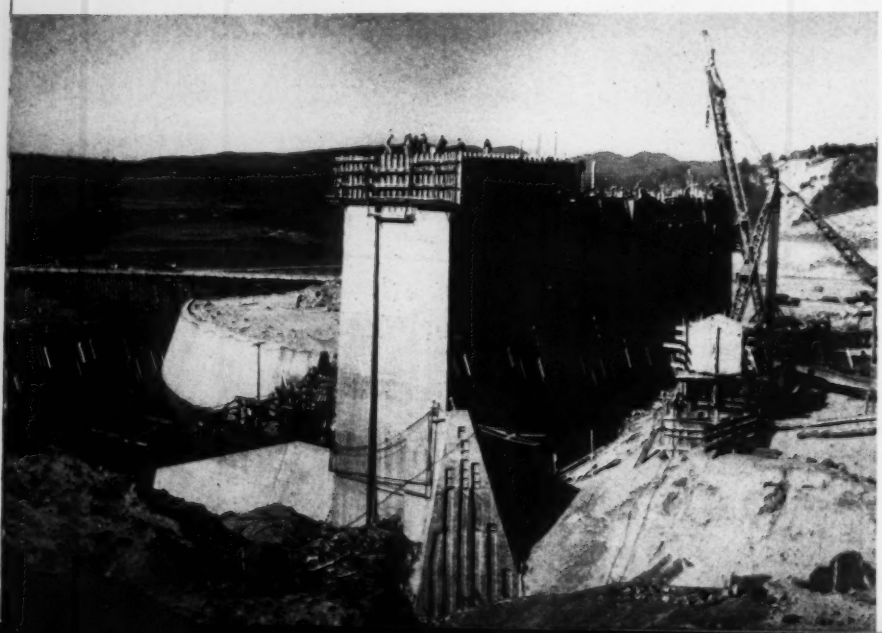
DENISON DAM AND RESERVOIR—Construction of the Denison Dam and Reservoir on the Red River near Denison, Tex., was begun in September, 1939. It is being constructed by the U. S. Engineers under authority contained in the June 28, 1938, Flood Control Act at an estimated cost of $48,290,000. The project will consist of an earth embankment of the rolled fill type, outlet works, a concrete paved spillway and the powerhouse. The latter will have an initial installation of two 35,000-kw. units and provisions for the ultimate installation of three additional 35,000-kw. units. Construction of the outlet works has been completed except for the installation of the gantry crane. Construction of the main dam embankment and excavation for the spillway is approximately 38 percent complete, and construction of the substructures for the Washita River and Rock Creek Bridges St. Louis-San Francisco Ry. relocation Liggett to Platter and Lakeside to Mead Okla., is approximately 20 percent complete. Contracts for furnishing and installing two 56,000-hp. hydraulic turbines and governors for the Denison, Tex. powerhouse have been awarded, and bids for furnishing and installing two 36,842-kw. alternating-current generators were opened on Dec. 12, 1941. It is anticipated that invitation for bids for construction of the spillway will be issued during February, 1942. The entire project is now approximately 29 percent complete.

Denison Dam outlet works (below) are complete. At center are downstream ends of four conduits leading to power house (not built). Stilling basin is at right and intake in background.

U. S. Engineers photo



Intake structure and approach channel at Franklin Falls Dam (below) in New Hampshire. The dam, on earthfill structure, is 85 percent complete.



WALLACE LAKE DAM—Located in western Louisiana, the Wallace Lake project was started in August 1941 on Cypress Bayou, a tributary of the Red River. The dam is an earthfill structure 4,900 ft. long and 48 ft. high for flood control.

MERRIMACK FLOOD CONTROL—Blackwater Dam on the Blackwater River in New Hampshire, a tributary of the Merrimack River was completed during the year.

Franklin Falls Dam—Construction of Franklin Falls Dam on the Pemigewasset River, main tributary of the Merrimack, just above the confluence of the two streams was begun in November, 1939. It is a rolled earthfill of about 3,000,000 cu. yd., 1,700 ft. long and 130 ft. high. At the end of the 1941 construction season the work was 85 percent completed with the main embankment raised to within 10 ft. of the top. Most of the remaining work is in the spillway area.

Channel Work—On the lower river, channel work at Lowell, Mass., was put under way in August.

CONNECTICUT FLOOD CONTROL—One of the three dams being built for control of floods in the Connecticut River valley, Knightville, on the Westfield River in Massachusetts, was completed early in the year. Work on the other two, Birch Hill and Surry Mountain, is nearing completion.

Birch Hill Dam—Contract was awarded in May, 1940, for construction of this dam on Millers River in Massachusetts, a rolled-fill structure 1,400 ft. long and 60 ft. high containing 390,000 cu. yd. of material. Relocation of 4.5 mi. of the Boston & Maine's double-track main line was required. Work in 1940 was confined to start of the railroad relocation, to excavation of the permanent diversion channel and spillway foundations, and to construction of the central part of the fill between the river and the railroad. Diversion of the river was made in July and the railroad relocation was completed the same month permitting work on the entire dam. All work was substantially completed at the end of the year.

Surry Mountain Dam—This 900,000-cu. yd. rolled-fill structure, 1,670 ft. long and 86 ft. high, was started during the summer of 1939 on the Ashuelot River in New Hampshire. The fill was completed in October, 1941, and the completion of all concrete work, with the exception of the access road bridge deck, is expected by Jan. 15, 1942. Remaining concrete work,

together with minor quantities of road surfacing, sodding and seeding and clean-up, will be completed in the spring.

Dikes and Flood Walls—Work on dikes and flood walls to protect industrial areas on the main river in the neighborhood of Holyoke, Springfield and Hartford continued during the year, most of the structures being in service or nearing completion.

SANTEE-COOPER—Work on the Santee-Cooper power and navigation project in South Carolina was drawing to a close as the year 1942 opened. The Santee River was closed by the hydraulic fill of the 7.1-mile-long dam across that valley on July 8 and the river was diverted through six openings in the 3,400-ft.-long spillway. On Nov. 16 these spillway openings were closed, beginning diversion of the river through the canal cut to the reservoir in the Cooper River valley formed by Pinopolis Dam. Water in that reservoir is to be raised to create a head of 60 ft. at the powerhouse, as compared to the ultimate of 75 ft., pending completion of grouting along the dikes surrounding Pinopolis reservoir. Pinopolis Dam and its high-lift navigation lock are completed. The powerhouse is complete and units No. 1 and 2 are ready to put under load. One 13,300-hp. and two 40,000-hp. units are being installed; the ultimate capacity is 213,300 hp.

SUSQUEHANNA RIVER—Work on the current program for the Susquehanna River is nearing completion. It includes three dams, Arkport on the Canisteo River near Hornell, N. Y., completed in 1940, Indian Rock on Codorus Creek 3 miles above York, Pa., Whitney Point on the Otselic River near Whitney Point, N. Y., and levees, flood walls and channel improvements at Wilkes-Barre, Kingston, Plymouth, York and Williamsport, Pa. Whitney Point Dam is a 2,600,000-cu. yd. rolled earthfill, 4,300 ft. long and 90 ft. high. It is practically completed as is Indian Rock Dam, an earth and rockfill, 1,200 ft. long and 82 ft. high containing about 300,000 cu. yd.

COLORADO-BIG THOMPSON PROJECT—Green Mountain Dam, an irrigation storage and compensation reservoir on the Blue River, is 80 percent complete, farthest along of all units on the huge Colorado-Big Thompson project of the Bureau of Reclamation in Colorado. Next in point of progress is the 13-mi. Continental Divide tunnel. At the west or Grand Lake (intake) end, 7,200 ft. of heading has been driven, and driving is now stopped while the invert in this section is being placed. Phenomenal progress has been made on the east or Estes Park heading, where sustained progress of more than 60 ft. per day has been maintained. The heading is now in over 18,000 ft. from the portal. Automatic-controlled booster fans and a photoelectric-cell block signal system on the tunnel railroad are features of east heading construction. Bids were twice rejected last year for Granby Dam, main storage and control reservoir of the project, but contract was awarded for the diversion tunnel at the damsite. The dam may again be advertised this spring. No work has started on the power plants in Big Thompson Canyon, on the transmission line between these proposed plants and Granby Dam pumping plant across the Divide, or on Shadow Mountain Dam, which will enlarge Grand Lake as the intake to the tunnel.

PROVO RIVER PROJECT — With the main storage at Deer Creek Dam completed during the year and the 3½-mi. Alpine-Draper Tunnel lined, the Provo River Project, being built by the U. S. Bureau of Reclamation, in Utah, is now getting into the concluding stage. Deer Creek Dam is a rolled-earth structure 235 ft. high, containing about 2,750,000 cu. yd. of fill, and has been under construction during three seasons. Casting and laying of 12.6 miles of concrete pipe has been completed on the Salt Lake Aqueduct section of the project, leaving the Provo River Canyon section and about 28 miles at the Salt Lake City end to be placed under contract. On the upper end of the project, the 5½-mi. Duchesne Tunnel, which will deliver supplemental water into the Provo River, is now 50 percent completed.

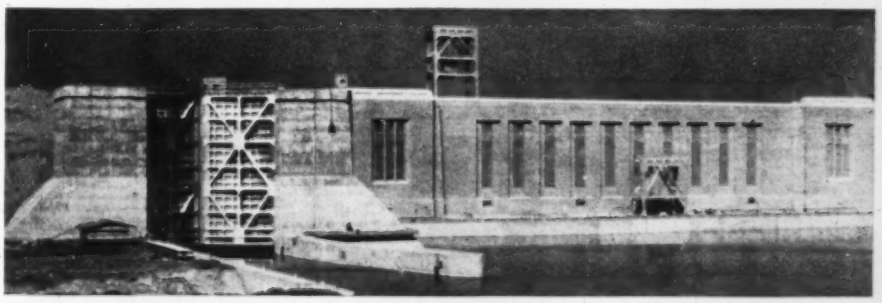
SOUTHERN CALIFORNIA—Flood control works, including channel improvement and the construction of storage dams, have been carried on during the year in southern California principally under supervision of the U. S. Engineer Department. Progress on some of the more important projects is reported in the following:

Prado Dam—This structure, completed in the early part of the year, at a total cost of about $9,500,000, creates a retarding basin with an impounding capacity of 224,500 acre-ft. at the level of the spillway crest. The structure itself, a rolled earthfill on the Santa Ana River in Orange County, is 2,280 ft. long on the crest, 850 ft. through at the base and 105 ft. high above streambed. It contains some 3½ million cu. yd. of earthfill and is faced on the upstream side with a paving of hand-placed rock on a 6-in. layer of crushed rock. Ungated openings in this structure (in addition to the larger control gates) prevent the reservoir from functioning as more than a flood storage project.

Fullerton Dam—Located about 2 mi. northeast of Fullerton in Orange County, Fullerton Dam was also completed early in the year at a cost of $425,000. This structure, also used for flood control exclusively, has a crest length of 620 ft., a height above streambed of 45 ft. and a storage capacity of 1,290 acre-ft.

Santa Fe Dam—Ground-breaking ceremonies were held early in November at the Santa Fe Dam site at the junction of the San Gabriel and Rio Hondo Rivers near Azusa and Duarte. Because of the width of

Powerhouse and navigation lock are complete for Pinopolis Dam of the Santee-Cooper power and navigation project in South Carolina.



Completed Deer Creek Dam (below) of the Provo River project in Utah is a 235-ft. high, 2,750,000-cu. yd. earthfill.

Bureau of Reclamation photo

the alluvial cone at the damsite, the length of this structure will be 23,800 ft. This is necessary to assure retention of flood waters that have been in the habit of changing the channel from time to time. In plan the structure will have a "U" shape; some of its length will be little more than dikes but the storage to be developed is expected to do much toward replenishing underground water supplies because the porous nature of the underlying strata will permit of rapid infiltration into subterranean basins while flood waters are held in storage. Maximum height of this structure is to be 92 ft.; the dam will contain about 12,000,000 cu. yd. of fill; date of completion is set for late in 1942. Cost is estimated at $8,900,000, not including rights-of-way.

Sepulveda Dam—All of the rolled fill, concrete, and machinery installations are complete. Highway, railroad, and utility relocation is ended. Work is in progress on the upstream channel and completion is expected at an early date.

Brea Dam—All of the rolled fill in the embankment, concrete, and machinery installation for the control works are complete. Excavation for the spillway is complete and concrete operations are in progress. Completion is expected early in 1942.

YAZOO BASIN FLOOD CONTROL—In the Yazoo River Basin in Mississippi the Sardis Dam flood control project, which is to store 1,570,000 acre-ft., was placed in operation last year. The Arkabutla Dam on the Coldwater River, a tributary of the Yazoo, is now well advanced with 75 percent of the impervious embankment in place for the 10,000-ft. long earthfill dam and excavation for the spillway 60 percent done. Already complete are the outlet works. Channel improvements on the Yazoo and its tributaries are nearing completion. All the work is being carried out by the U. S. Engineers.

ATCHAFALAYA BASIN—Improvements in the Atchafalaya Basin have centered principally around the Morganza floodway and the new Wax Lake outlet, which is a 15-mile long channel connecting Grand Lake with Atchafalaya Bay in the Gulf of Mexico. In the Morganza floodway proper, the upper and lower guide levees, aggregating 10,140,000 cu. yd., have been completed at a cost of $1,310,000. Practically complete is the $6,000,000 Wax Lake outlet, which is designed to by-pass 275,000 cfs. from the Atchafalaya's natural outlet at Morgan City in times of superflood, when the river may be carrying 1,500,000 cfs. A total of 57,290,000 cu. yd. was dredged out of the new channel. Work on the railroad and highway crossings and on drainage structures in the basin, to cost another $3,197,000, remains to be completed. The 115-mi. long West Atchafalaya Basin protection levee is about done and 32,264,000 cu. yd. have been placed for protection levees for the 86-mile long East Atchafalaya Basin. The work is being done by the U. S. Engineers.

MISSOURI RIVER BASIN—The two major projects on the Missouri River system are Fort Peck and Kanopolis Dams, and both structures are being built by the U. S. Engineers.

Fort Peck Dam—Placement of 122,700,000 cu. yd. of fill for this dam, which is on the headwaters of the river in eastern Montana, and is for flood control, navigation and power, was completed late in 1940. Work during the past year at the site has been confined principally to building penstocks and foundations for the powerhouse.

Kanopolis Dam—Nearly half of the embannkment required for the 3-mile long earthfill Kanopolis Dam was placed in 1941 and the outlet works were completed. This 140-ft. high dam is being built 30 miles southeast of Salina, Kansas, on the Smoky Hill River, a tributary of the Missouri, to provide storage for 450,000 acre-ft.

TENNESSEE RIVER AND TRIBUTARIES—The Tennessee Valley Authority has now completed and placed in full operation Norris, Wheeler, Pickwick Landing, Guntersville, Chickamauga, and Hiwassee Dams. Eight dams and a steam power plant are in varying stages of completion and additional generating equipment is being installed at other dams. The construction status at the various sites follows:

Kentucky Dam—The placing of concrete in the lock has been completed and the lock gates installed. The second cofferdam, inclosing the powerhouse and nine bays of the spillway, is complete; excavation and foundation exploration are complete and concreting in this stage was started June 24, 1941. The cofferdam is the highest of the cellular type ever used and employs cloverleaf design for the river sections. First power from the five authorized 32-000-kw. units is scheduled for February, 1944.

Watts Bar Dam and Steam Plant—The lock, spillway, and embankments have been completed. Five 30,000-kw. units are being installed in the powerhouse. Reservoir filling is scheduled to begin in January, 1942, and the first power unit should be in operation in February, 1942. Three 60,000-kw. steam generating units are under construction in a plant near the dam. The first two units are scheduled to be put in operation in January and April, 1942. The third unit has only recently been authorized.

Fort Loudoun Dam—Concreting in the lock, started Jan. 15, 1941, is now about 50 percent complete. Excavation for the spillway has been started and the earth embankment work is proceeding rapidly. The first two 32,000-kw. units are scheduled

Closure of the 1,500,000-cu. yd. combination earth- and rockfill Nottely Dam (below) in the Hiwassee River basin is scheduled for Feb. 1.

TVA photo

Five 30,000-kw. units are being installed at Watt's Bar Dam (below) where the lock, spillway and embankments are complete.

TVA photo

for initial installation with provision for the ultimate installation of four units. The first power is scheduled for September, 1943.

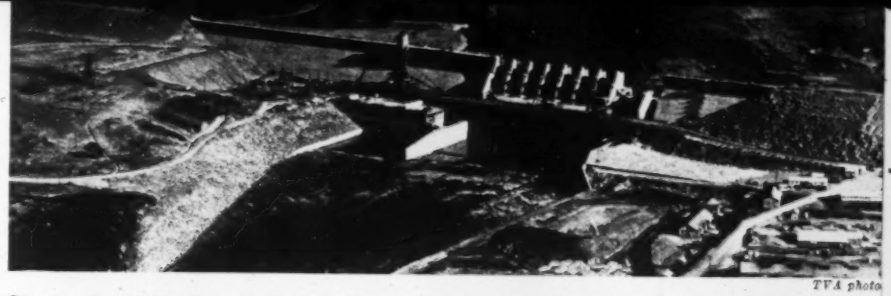
Cherokee Dam—The dam is practically completed. The gates of the outlet conduits were closed on Dec. 5, 1941, and the reservoir filling is under way. The project, which was authorized on July 31, 1940, was closed in approximately 16 months. The first power unit is now scheduled for operation in April, 1942.

Hiwassee Projects—The Apalachia, Ocoee No. 3, Chatuge, and Nottely Dams in the Hiwassee River basin were authorized by Congress on July 16, 1941. Closure of Chatuge and Nottely Dams is scheduled for Feb. 1, 1942. Chatuge is an earthfill dam containing approximately 2,220,000 cu. yd.; Nottely is a combination earth- and rockfill dam containing 850,000 cu.yd. of earth and 700,000 cu.yd. of rock. No power units are scheduled for immediate installation at Chatuge or Nottely. The Apalachia project consists of a 272,700-cu.yd. concrete gravity dam and a tunnel 42,700 ft. long. It will be closed in September, 1942, and the first power from its two 37,500-kw. units is scheduled for February, 1943. Ocoee No. 3 is also a gravity dam, containing 100,000 cu.yd. of concrete and it has a tunnel 13,000 ft. long. The dam will be closed in September, 1942, and the first power from its single 24,000-kw. unit is scheduled for delivery in February, 1943.

Additional Units—Two additional 36,000-kw. generating units are now being installed at Pickwick Landing Dam; six additional 26,000-kw. units are being installed at Wilson Dam to supplement the eight initially constructed; and two 32,000-kw. units were completed at Wheeler Dam during 1941, raising the installed capacity there to 128,000. Some dredging is under way at Pickwick, Guntersville and Chickamauga Dams to provide the desired 9-ft.-deep waterway on the Tennessee River.

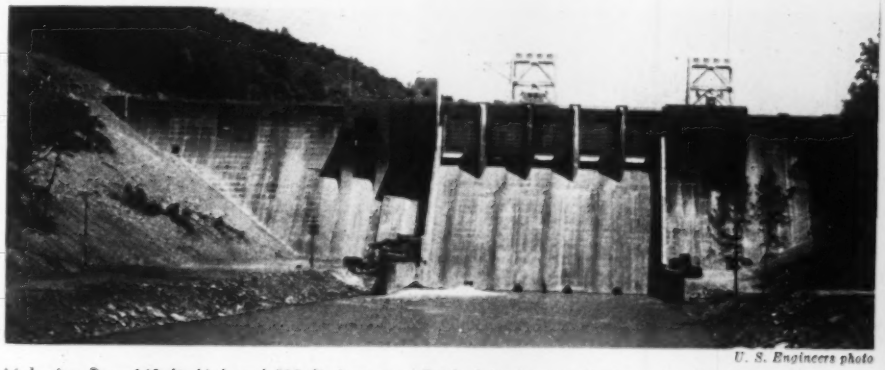
New Aluminum Co. Dams—The Aluminum Co. of America put into operation the 27,000-kw. Glenville Dam in October of this year and expects soon to add the 54,000-kw. plant at Nantahala Dam to its system for producing energy for the manufacture of aluminum. Both dams are rock- and earthfills with long tunnels, which provide high operating heads. Glenville has a maximum static head of 1,215 ft. and Nantahala boasts of 1,005 ft. The dam proper at Nantahala will be completed in January and put in operation later in the spring.

SAVAGE RIVER DAM—This $5,225,000 dam and reservoir in the Big Savage River canyon 5 miles northwesterly from Luke, Md., is being carried out by the Work Projects Administration of Maryland with the Upper Potomac River Commission as sponsor. This dam and reservoir is the largest project of the type that has so far been attempted by WPA. About 2,800,000 cu.yd. of earth and 600,000 cu.yd. of rock will be moved to make a rock face earth embankment dam, which will be 188 ft. high and 1,600 ft. long at the crest. Work is now 55 percent complete with closure scheduled for 1942. Dam will increase minimum flow of the Upper Potomac.



TVA photo

Cherokee Dam (above) on the Holston River is practically complete with power production to start next April. Outlet conduit gates were closed 16 months ahead of schedule.



U. S. Engineers photo

Mahoning Dam 160 ft. high and 993 ft. long, was finished in June as fourth major flood-control dam to be completed on Upper Ohio tributaries.

WOLF CREEK DAM—Construction was begun in September by the U. S. Engineers on the $35,000,000 Wolf Creek flood control project on the Cumberland River in southeastern Kentucky. Operations during the year consisted mainly of preliminary work and the installation of the construction plant. The dam will have a maximum height of 242 ft. and a total length of 5,730 ft., of which 1,836 ft., comprising the powerhouse, spillway and retaining section, will be of concrete and the remainder of rolled-earth fill. No power installation is at present under contract.

UPPER OHIO TRIBUTARIES—Mahoning Dam, a concrete gravity structure 160 ft. high and 993 ft. long, was completed in June of this year. This is the fourth major dam to be completed on tributaries of the upper Ohio for protection of industries in the Pittsburgh district. Structures previously completed are Tygart, Tionesta, and Crooked Creek Dams.

Loyalhanna Dam—This is a concrete gravity structure with a height above stream bed of 113 ft. and an over-all length of 970 ft., and it will require 120,000 cu.yd. of concrete. Construction is well along with completion scheduled for early in 1942.

Youghiogheny Dam—This rolled fill structure, located on a tributary of the Monongahela River, will have a volume of about 3,000,000 cu.yd. of material in its 184-ft. height and 1,600-ft. length. An 18-ft.-dia. tunnel 1,765 ft. long is provided through one abutment. The structure is scheduled for completion early in 1945.

Bluestone Reservoir Project—Bids were opened on Dec. 23 for construction of the dam for the Bluestone Reservoir project near Hinton, W. Va. The contract specifies that work shall start in January, 1942, on this concrete gravity-type dam, which will be about 2,060 ft. long with a maximum height of 180 ft. and will require about 1,000,000 cu.yd. of concrete.

DAMS COMPLETED DURING 1941

Friant, irrigation dam on the San Joaquin in California.

Mud Mountain, flood-control structure on the White in Washington.

Nimrod, flood-control project on the Fourche La Fave in Arkansas.

Blackwater, for control of floods on the Blackwater in New Hampshire.

Knightville, one of three dams being built for flood control in Connecticut River Basin.

Whitney Point and Indian Rock, of the Susquehanna River flood-control work.

Deer Creek of the Provo River work in Utah, for irrigation and providing a new water supply for Salt Lake City.

Prado and Fullerton, two flood-control projects in southern California.

Watts Bar and Cherokee, of the Tennessee Valley Authority work.

Mahoning, an Upper Ohio flood-control development.

Wappapello, first major project for controlling floods on the St. Francis in Missouri and Arkansas.

Kingsley, power and irrigation development on the North Platte in Nebraska.

Vallecito, water storage project on the Pine in Colorado.

Glenville, power dam on the upper tributaries of the Tennessee.

Marshall Ford, flood-control, irrigation and power project on the Colorado River of Texas.

TRANSPORTATION

NEW YORK CITY PARKWAYS—The parkway system of the New York City area was increased by several miles during the past year. On Oct. 11 the 3½-mile-long Hutchinson River Parkway extension was dedicated. This new $7,148,000 expressway, which provides three lanes of traffic each way, extends from the Bronx-Whitestone Bridge northward to the Hutchinson River Parkway and it is designed to relieve traffic on Eastern Boulevard. Another parkway extension to go into service was a 2.7-mile-long section in Brooklyn of the elevated Gowanus Parkway from Owl's Head Park to Prospect Ave. This section, which in part makes use of an abandoned railroad, provides two lanes of traffic each way. The remaining portion of the Gowanus Parkway, or the 0.7-mile-long route from Prospect Ave. to the Brooklyn plaza of the Battery-Brooklyn tunnel, is nearly completed and is expected to go into service at an early date to provide three lanes of traffic each way. The Gowanus Parkway is costing $15,000,000.

LONG ISLAND R.R. GRADE SEPARATIONS—Through the New York State Transit Commission the state of New York is spending $23,800,000 to eliminate 20 grade crossings on a 5-mile-long section of the Long Island R.R. along Atlantic Ave. from Jamaica to the eastern edge of New York City. This project, which is placing the railroad underground, was 75 percent complete Jan. 1, 1942, and temporary service of the new structure is expected May 1, 1942. The commission is also spending $11,650,000 to eliminate 39 crossings on a 5.5-mi. section of the railway from Rockaway Park to Far Rockaway. This project is a double-track elevated structure and 1.7 miles of the new line was placed in service about a year ago. The entire project was 87 percent complete Jan. 1, 1942, and all the work is to be completed July 1, 1942.

PHILADELPHIA HIGHWAYS—Philadelphia, in cooperation with the Common-

A 3½-mile long express route providing three lanes each way from the Bronx-Whitestone Bridge northeastward to Hutchinson River Parkway was dedicated Oct. 11 at New York City. Photo is looking eastward towards Westchester.

Fairchild Aerial Surveys photo

wealth of Pennsylvania, has begun a highway improvement program on state routes entering and leaving the city, on which $12,000,000 annually is to be expended during the next two years. This new work results from state legislative action permitting the use of state revenues derived from motor license fees to be spent for the elimination of bottlenecks, widening of bridge approaches, and construction of new arterial highways. The act enables Pennsylvania to condemn properties for improvements and to pay the damages. Physical construction will get under way very soon.

WILBUR CROSS PARKWAY—Construction was carried forward actively on Wilbur Cross Parkway, a superhighway crossing Connecticut diagonally from the eastern end of the Merritt Parkway near New Haven to the Massachusetts state line southwest of Worcester. About 20 miles was completed during the year and construction of additional sections, including a crossing of the Connecticut River at Hartford, is underway.

CHICAGO SUBWAYS—Major construction activities on the Chicago subways shifted during 1941 from mining and concreting of tubes to building subway stations and equipping the system for operation. Out of 29 stations on the system, 26 have been completed except for architectural finish and the installation of lighting fixtures, station control equipment and escalators. The value of construction work completed to Dec. 1 is $39,299,864, exclusive of engineering and right-of-way costs, but including station construction, 77,750 ft. of single tubes, and important equipment items that are already in place. Additional construction work under contract totals $5,230,897. New contracts awarded during the year aggregate $5,002,900.

Peter Fish photo

Construction of the Monroe-Adams Sts. station of the State St. section of Chicago's new subway system. Major work is completed on 26 stations.

To meet the exigencies of construction under defense conditions, the subway department revised important parts of its construction program, including revision of specifications to eliminate or reduce use of critical materials, and adoption of a special type of contract (*ENR*, Oct. 29, 1941).

Along Atlantic Ave. (above) a 5-mi. long section of the Long Island R. R. is being placed underground to eliminate 20 grade crossings in the New York area. On the Rockaway project (below) a 5.5-mi. section is being transformed into an elevated structure to eliminate 39 crossings. Included in the latter project is construction of 4.8 mi. of new 4-lane asphalt roadways between and adjacent to the elevated structure.

LINCOLN TUNNEL, New York City—Construction is again in progress on the Lincoln Tunnel under the Hudson River where only one tube of the twin tubes originally driven is open to traffic. An approach plaza is being opened up on the Manhattan end (the New Jersey approach was completed in the original construction) and the ventilation buildings are under contract but construction on them is not yet under way. Contract for roadway paving and other work to complete the interior of the tunnel will be let in time to assure completion when the other facilities are ready.

BATTERY-BROOKLYN TUNNEL—The Battery-Brooklyn Tunnel, connecting the lower tip of Manhattan with Hamilton Ave. in Brooklyn, has advanced to the tunnel driving stage. The shafts in both Manhattan and Brooklyn have been completed and driving of the twin tunnels from these shafts have begun. Bids on a construction and ventilating shaft at the tip of Governor's Island and on tunnel driving each way from that shaft to meet the Brooklyn and Manhattan headings were called late in 1941 but were cancelled after war was declared. Present plans are to proceed with the shield driving from the Brooklyn and Manhattan shafts as only a small amount of critical material will be required, most of the cast-iron lining having been fabricated under contracts let late in 1940. The date of completion is uncertain. Before priorities began to affect the work, completion was scheduled for 1944.

Official U. S. Navy Photo

Two thin barrel-shell-roof hangars with main arch ribs of 294-ft. span and 81-ft. rise under construction for the Navy at San Diego, Calif. Footings for the two-hinged arch ribs are supported on piles and tied together by bridge strands.

BUILDING PROJECTS OF 1941

ABOUT TWO-THIRDS of all construction expenditures last year were absorbed by building projects, for the most part huge industrial establishments for the manufacture of war materiel. Tied thus to our national defense, nearly every one of these projects is of national interest and therefore a candidate for these pages. Space limitations precluding such an extensive coverage, a group of typical examples of various building types is presented as an alternative. Enough of both the usual and the unique is given that the structures shown may be fairly considered to represent what the year developed in the field of buildings. That variety, technical excellence, spectacular quality and substantial construction are reflected by this typical group of buildings should be a source of pride to all engineers and construction men. Designed and built under rush schedules, the buildings measure up and in some instances surpass anything that has been done more leisurely.

Samuel H. Gottscho Photo

The National Gallery of Art (above) in Washington was officially opened March 17 by President Roosevelt as gift to the American people from the late Andrew W. Mellon. The structure is 782x303 ft. in plan and is completely air conditioned.

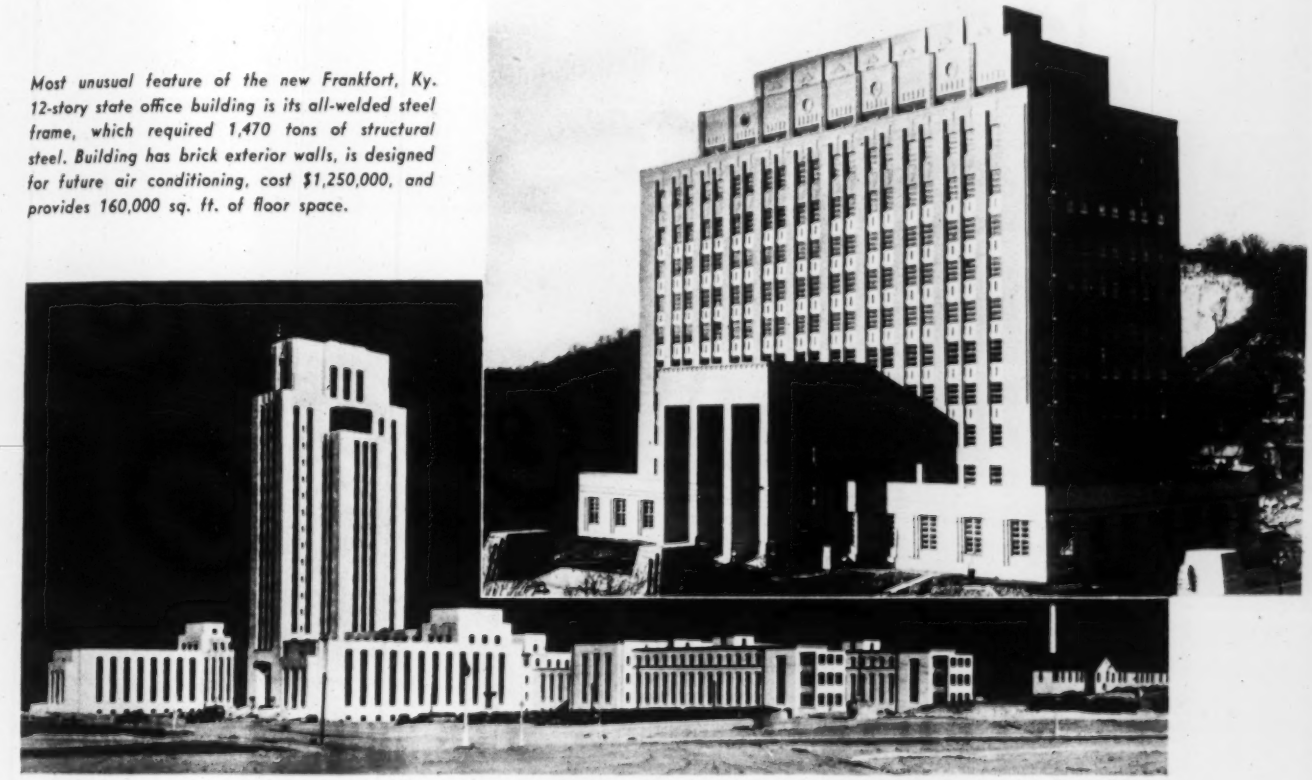
Boeing's Seattle plant (below) now has over 42 acres under one roof as compared to 150,000 sq. ft. of floor space early in 1940.

Austin Co. Photo

Consolidated Aircraft's Fort Worth 4,000x320-ft. bomber assembly plant is one of largest industrial buildings ever constructed and includes the ultra-modern wall design feature of fiber glass mats for insulation.

Kentucky Intrastate News photo

Most unusual feature of the new Frankfort, Ky. 12-story state office building is its all-welded steel frame, which required 1,470 tons of structural steel. Building has brick exterior walls, is designed for future air conditioning, cost $1,250,000, and provides 160,000 sq. ft. of floor space.



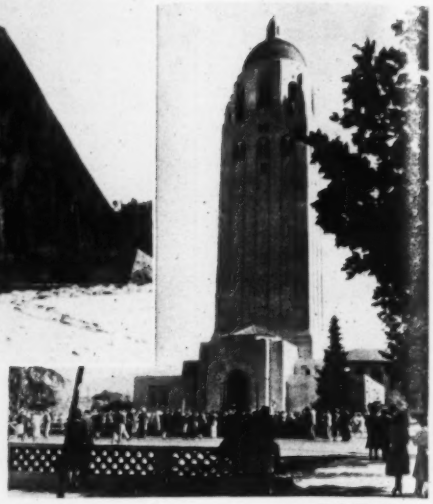
Official U. S. Navy photo

Precast concrete facing was used for Navy's Bethesda, Md. Medical Center (above), including 20-story tower.

Blackout shutters can be installed over the five lines of 10-ft.-high monitors on this new Republic Aviation Corp. plant, which is equipped with 42 rows of fluorescent fixtures 500 ft. long.

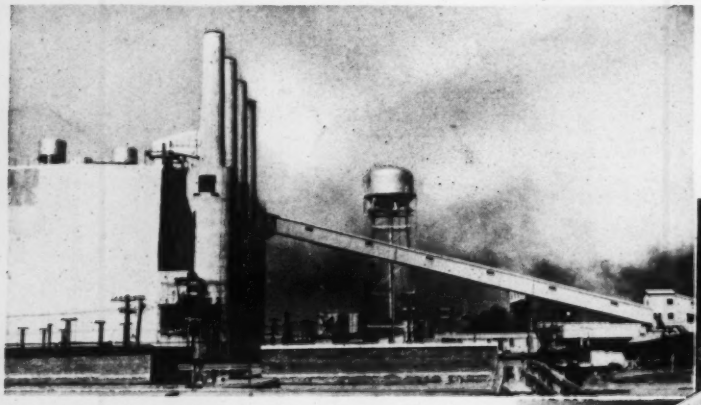
William W. Thomas photo

Constructing thousands of igloos for storage of live munitions has been one of the distinctive features of the defense building program.

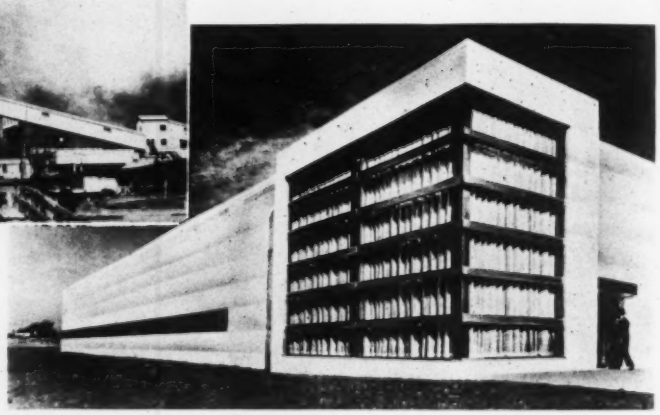


Wide World photo

Reinforced-concrete walls provide earthquake resistance acting with the steel frame of the Hoover Library at Stanford University.



Nation's powder plants required powerhouses like above, which houses eleven 5,000-kw. turbo-generators at Charlestown, Ind.

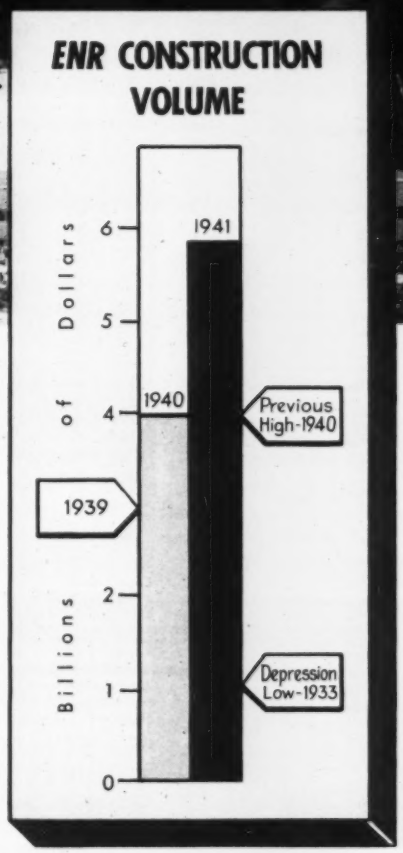


Marble exterior walls, structural glass interior walls, stainless steel trim and air conditioning feature Johnson & Johnson factory (right) at New Brunswick, N. J.

Magnolia housing project at New Orleans, a 723-unit development costing $2,500,000, which is typical of the nation's housing program.

Aerographic photo

Construction Goes to War



Engineers and contractors broke all their previous accomplishment records with the engineering construction volume they turned out in 1941. This was the eighth successive year of gains. Defense was the driving force directly responsible for two-thirds of the total volume. Military needs more than doubled the public building 1940 record and boosted unclassified construction beyond the previous high, and effective spreading of defense work sites produced new high records for construction volume in five of the six regions. Public awards reached a new all-time pinnacle, and private work a ten-year high. In the succeeding nine pages are the full detailed reports of the achievements of construction men in 1941, together with the goal set for 1942.

CONSTRUCTION VOLUME
CONSTRUCTION FINANCING
ENR CONSTRUCTION TOTAL
RESIDENTIAL BUILDING SUMMARY
CONSTRUCTION EMPLOYMENT
CONSTRUCTION MATERIAL SHIPMENTS
CONSTRUCTION COSTS
CONSTRUCTION WAGE RATES
CONSTRUCTION MATERIAL PRICES

Photos by Acme Newspictures, Inc., and ENR Staff

Construction Hits Stride in War Effort

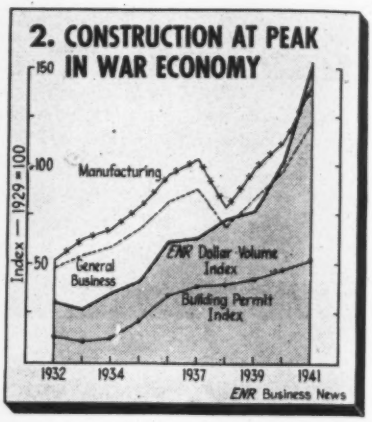
THE WAR OF NERVES and the game of playing for time is over, replaced by the realities of a grim struggle to overtake in production and military facilities, enemies with a head start of several years of preparation and planning. But 1941's all-time record defense construction achievements in both volume and speed enable the United States to schedule an even greater war construction effort for 1942.

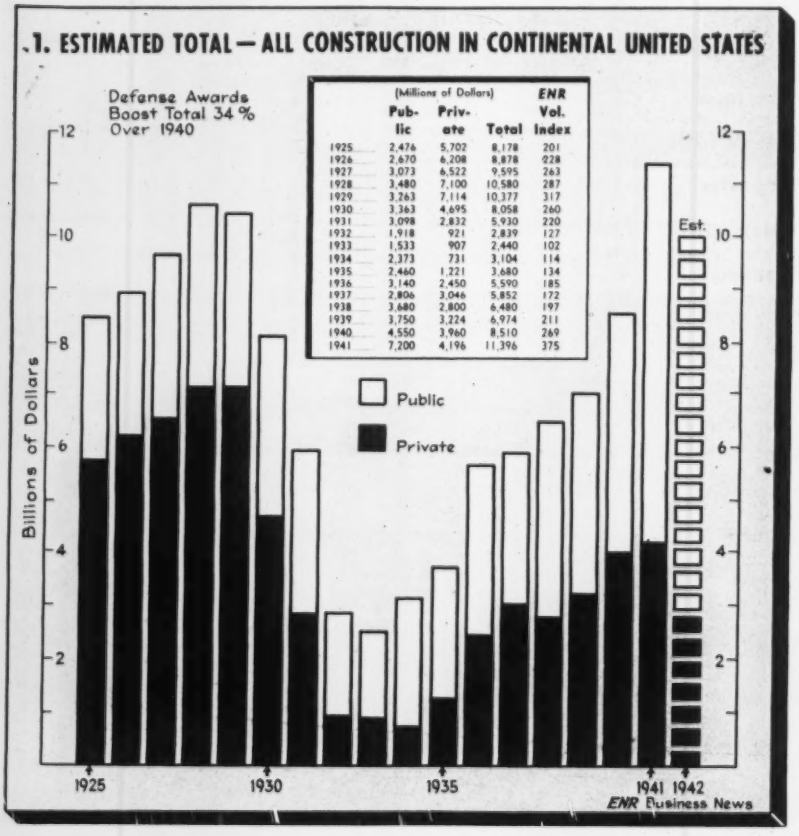
Defense construction reached almost 7½ billion dollars in 1941, 65 percent of the record $11,396,000,000 estimated for the total of all construction in the continental United States. The year before the defense effort accounted for 35 percent of the $8,510,000,000 volume.

Expansion of war production and military facilities, which stepped up engineering construction dollar volume by 47 percent and physical construction volume by 39 percent, also boosted both general business and manufacturing to new highs during the year. The Federal Reserve Board Index of industrial production climbed 27 percent over the previous high of a year ago, and the Business Week Index of general business rose 26.5 percent over 1940, and 22 percent over the peak year, 1929.

The $11,396,000,000 estimated construction total was brought about by the fourth successive record-breaking public volume, $7,200,000,000, and the highest private engineering and residential construction estimated total since 1930, $4,196,000,000. The private total climbed 6 percent over a year ago, with residential building setting the pace with an 8 percent gain and reaching the highest volume reported since 1929. Private engineering construction, which includes apartments, hotels and industrial facilities, was up 4 percent over 1940, which was the previous highest estimated total since 1930.

Estimated federal construction, $5,300,000,000, climbed 130 percent above the previous high of 1940 as a result of the emphasis placed on defense work. State and municipal volume estimated at $1,900,000,000 declined 15.5 percent from 1940. These estimates of public and private construction are shown in both table and chart form in Chart 1.





The *ENR* Construction Volume Index (the measure of physical construction, dollar volume adjusted for changes in cost) rose to 375 in 1941, a 39 percent increase over the 1940 average of 269, base 1913 = 100.

Close to $8,000,000,000 in new construction funds were made available to the industry during 1940, more new money than in any other year in history. This huge financing volume more than doubled last year's mark. Consistent with the increased emphasis on defense, over four-fifths of the funds, $6,514,368,000, were for federal projects. Cost of financing declined for all types of high grade bonds from the low rates of 1940.

Construction costs averaged a 6.5 percent increase over a year ago, and building costs climbed 4 percent according to *ENR* indexes measured by changes in wages rates and material prices only. (On jobs subject to emergency conditions of overtime, labor scarcity, low labor efficiency, etc., ratios of cost increases are higher.) Labor rates for common labor rose 6 percent over their average for the preceding year, and the skilled labor average was up 1.5 percent. The lumber component of the cost index at the year end topped the January, 1941 figure by 11 percent.

The outlook for 1942

Before Pearl Harbor, tentative construction volume estimates for 1942 were set at $9,500,000,000, a decline from the $11,400,000,000, record of 1941. This decline was all in non-defense, "non-essential" construction, affecting chiefly residential building in non-defense areas and local public works. This estimate included an increase in defense construction.

Immediately after Pearl Harbor this $9,500,000,000 estimate was stepped up to $10,000,000,000, and may be subject to further increase up even to 1941 volume when the military strategy to be adopted reveals itself and as new facilities for prosecuting the war are put under construction. War construction will be the dominant factor in 1942 construction, probably accounting for 80 percent of the total estimated volume.

The recent $10,000,000,000 appropriation act passed directly after our formal war declaration includes almost $2,500,000,000 for construction of war plants, naval shore establishments, defense housing, airports, army air fields, etc. This huge construction fund, except for last minute changes, however, was based on pre-war needs. Further large requests for funds to prosecute the war are expected in January. Already in process of legislation is the request for $845,000,000 to expand shipbuilding and repair facilities, and it is possible that additional funds may be asked for army cantonment facilities.

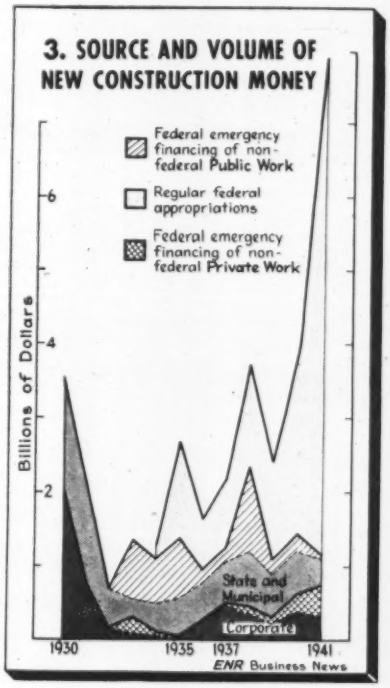
Defense housing appropriations passed the billion-dollar mark in late December with the $600,000,000 made available, $300,000,000 in the National Defense Emergency Appropriation Act of 1942, and $300,000,000 in the Third Supplemental National Defense Act of 1942. An additional $150,000,000 was appropriated for local public works, doubling the program that was just getting under way late in 1941.

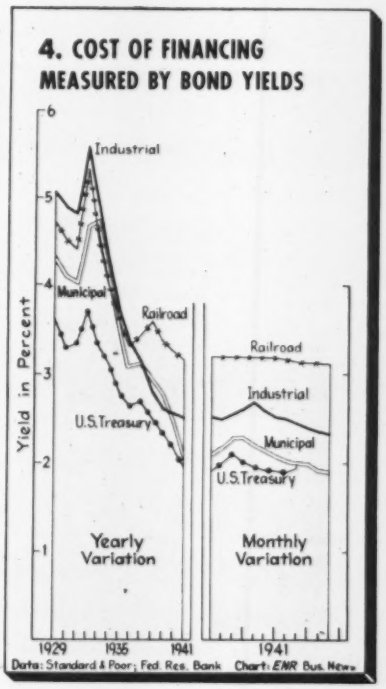
These large appropriations, combined with unexpended balances from the 1941 program, and forthcoming funds, insure a near-record level of construction during 1942.

Construction costs began the new year with increased wage rates, and minor gains in lumber. The establishment of price ceilings on major construction materials is expected to hold the material component of the index close to present levels for 1942, but labor costs are less predictable and at this writing not being subject to set ceilings.

In the succeeding sections of this statistical review of 1941, pertinent data on construction financing, recorded engineering construction, residential building, employment trends, material shipments, costs and wage rates in the construction field are reported in greater detail.

Construction Financing





CONSTRUCTION FINANCING in 1941, $7,895,129,000, topped the preceding year's volume by 103 percent. The bulk of the total, $6,514,368,000 was for federal construction, 186 percent greater than the government funds provided in 1941. Corporate expansion funds received from bond issues and from federal agencies gained 19 percent over a year ago. State and municipal construction financing dropped 41 percent and federal-aid for highways, $163,000,000, a sum that must be matched by state financing, was 11 percent below 1940.

Cost of construction money as measured by high-grade bond yields continued to decrease in 1941 for U. S. Treasury, state and municipal, railroad, industrial, and public utility bonds. Yields of municipals were 16 percent under the previous all-time low of a year ago, and treasury bond yields also reached a new low. Industrial and public utility bond yields were each down 2.5 percent, and railroads were off 3 percent.

The 1941 annual average yields for the various types of high-grade bonds in percent are: municipal, 2.10; industrial, 2.50; public utility, 2.69; and railroad, 3.16.

II—NEW CONSTRUCTION CAPITAL

(Millions of Dollars)

	Corporate	State and Municipal	Federal	Total
1925	$1,966	$1,352	.....	$3,318
1926	1,824	1,344	.....	3,168
1927	1,784	1,475	.....	3,259
1928	1,568	1,379	.....	2,947
1929	1,758	1,418	.....	3,176
1930	2,032	1,434	.....	3,466
1931	787	1,235	.....	2,022
1932	159	561	.....	720
1933	292	1,091‡	.....	1,383
1934	77†	1,011‡	194	1,282
1935	47†	1,337‡	1,354	2,738
1936	251	698‡	691	1,640
1937	518†	738‡	946	2,202
1938	457†	1,902‡	1,345	3,704
1939	304†	783‡	1,318	2,405
1940	624†	805‡	2,466	3,895
1941	741†	477‡	6,677	7,895

Note:—Federal appropriations include federal-aid highway, WPA, and regular departmental appropriations for construction.

† Includes $237,000,000 RFC and PWA loans '33; $55,000,000, '34; $9,000,000, '35; $807,000, '37; $76,106,000 REA, $4,500,000 RFC loans, '38; $89,000,000 REA and $400,000 RFC loans, '39; $40,000,000 REA and $193,000,000 in RFC loans '40; $100,500,000 in REA and $282,000,000 in RFC loans in '41.

‡ Includes $814,000,000 RFC and PWA loans and grants, '33; $580,000,000, '34; $808,000,000, '35; $164,700,000, '36; $207,000,000, '37; $723,265,000 PWA, $99,844,000 RFC, $320,986,000 USHA loans, '38; $216,000,000 in USHA loans, '39; $219,000,000 USHA, $5,000,000 RFC loans in '40; $30,000,000 in USHA, $6,900,000 in RFC loans in '41.

ENR Construction Near Six Billion

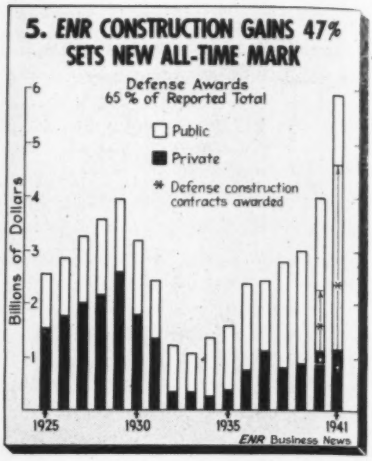
ENGINEERING CONSTRUCTION awards recorded by *ENR* in 1941 climbed to $5,868,699,000, the highest volume in history, and 47 percent above the previous all-time mark of 1940. Of this total, $3,823,397,000, or 65 percent, is defense construction. The *ENR* total includes all engineering construction in continental United States as reported in Table III and Chart 6.

Public awards reached $4,690,617,000, boosted to a new record by defense work, and 66 percent above the former high of 1940. Defense was responsible for $3,405,798,000 or 73 percent of this total. Federal work, $3,500,488,000 climbed to a new peak, 141 percent over the 1940 total, and was responsible for the public gain as state and municipal awards, $1,190,129,000, were 13 percent below a year ago.

Private construction, $1,178,082,000, topped the preceding year by 1.5 percent and was the top figure reported since 1930. Of this, $417,599,000 was direct defense construction, 35 percent of the total.

Two new marks set

Almost two-thirds of the record-breaking 1941 recorded construction activity was concentrated in public buildings and unclassified construction, with both classes of work rising to new heights. Public buildings amounted to $2,785,585,000, a 133 percent increase over 1940. Nine-tenths of this award total, $2,511,893,000, was for defense projects, $1,363,673,000 in government-owned



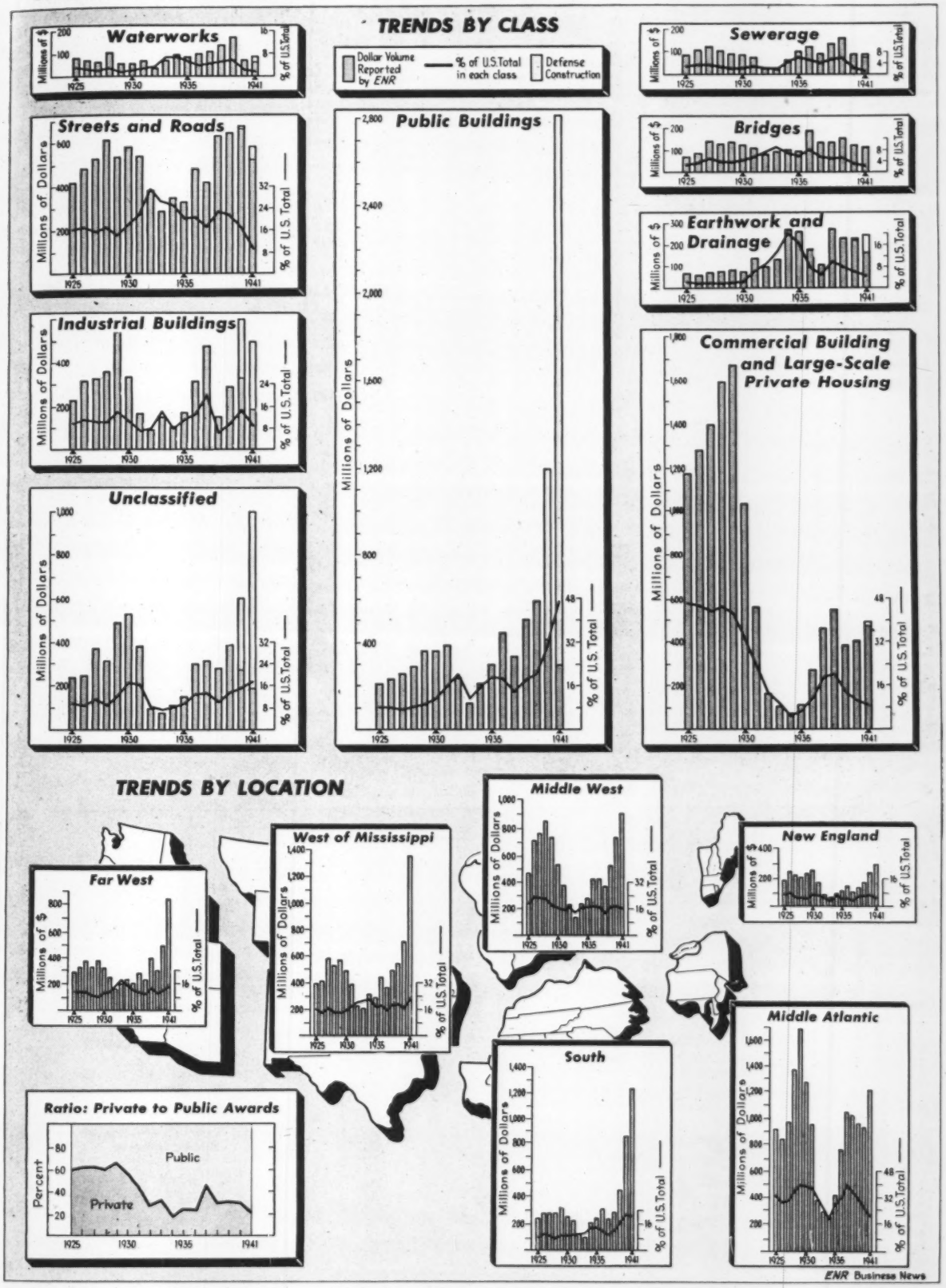
III—ENGINEERING CONSTRUCTION REPORTED IN 1941 BY *ENGINEERING NEWS-RECORD*

(Thousands of Dollars)

Minimum contracts reported: Waterworks, excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

States	Water-works	Sewerage	Bridges	Earth-work	Streets and Roads	BUILDINGS Indus-trial	BUILDINGS Com-mercial	BUILDINGS Public	BUILDINGS Un-classified	Federal Gov't Work	All Construction Private	All Construction Public	1941 Total	1940 Total	% Gain '41 '40
Me	451	263	1,279	637	3,425	1,785	1,500	4,583	26,211	23,458	10,446	29,688	40,134	14,820	171
N. H	356	.....	638	225	2,267	485	526	11,056	6,610	17,952	1,121	21,042	22,163	8,714	154
Vt	90	.....	323	21	1,845	450	300	802	538	827	902	3,467	4,369	4,647	—6
Mass	1,212	723	1,392	1,482	7,560	15,001	13,042	37,464	19,644	52,663	28,366	69,154	97,520	98,735	—1
R. I	10	713	193	373	1,246	4,428	2,150	11,683	10,752	17,065	6,753	24,795	31,548	40,723	—23
Conn	2,184	782	8,363	1,455	12,011	22,891	23,255	40,274	4,660	38,501	46,377	69,598	115,975	76,339	52
New Eng.	**4,303**	**2,481**	**12,188**	**4,193**	**28,354**	**45,040**	**40,773**	**105,862**	**68,515**	**150,466**	**93,965**	**217,744**	**311,709**	**243,978**	**28**
N. Y.	10,333	20,212	15,769	5,898	26,568	48,622	127,614	113,817	111,928	138,865	186,312	294,489	480,801	392,834	22
N. J	2,891	10,997	4,031	8,801	30,107	26,390	35,602	59,190	40,947	98,335	66,246	152,710	218,956	175,927	24
Pa	2,564	3,600	3,153	7,805	44,158	54,161	52,636	162,621	28,850	166,888	111,605	247,943	359,548	279,971	28
Md	501	1,526	1,616	482	12,201	14,175	3,051	37,308	22,314	58,741	17,769	75,405	93,174	62,060	50
D. C.	711	90	1,223	80	2,596	3,270	21,824	15,149	2,273	14,404	25,538	21,678	47,216	33,331	42
Del	.....	.....	123	1,918	1,411	575	4,050	921	2,668	4,502	5,025	6,641	11,666	7,376	58
Mid. Atl.	**17,000**	**36,425**	**25,915**	**24,984**	**117,041**	**147,233**	**244,777**	**389,006**	**208,980**	**481,735**	**412,495**	**798,866**	**1,211,361**	**951,499**	**27**
Va	1,083	422	4,036	687	8,933	3,616	11,909	88,085	16,332	105,092	16,535	118,568	135,103	167,675	—19
W. Va.	106	.....	755	2,664	5,534	8,485	425	19,406	2,537	21,313	9,553	30,359	39,912	30,538	31
N. C.	1,971	1,365	1,245	26,432	14,547	4,393	2,225	41,388	46,068	98,849	17,510	122,124	139,634	64,849	116
S. C.	958	301	3,616	5,402	8,447	2,278	200	22,599	15,324	31,506	5,425	53,700	59,125	46,362	28
Ga	2,424	235	980	13,307	6,465	2,302	565	55,898	42,588	108,877	8,842	115,922	124,764	69,561	79
Fla	6,285	2,084	3,647	1,549	12,981	5,069	3,509	27,312	39,060	56,792	11,867	89,629	101,496	148,834	—32
Ala	497	302	1,259	65	7,999	10,258	2,249	146,879	21,442	161,131	18,776	172,174	190,950	68,502	179
Miss	566	484	164	1,873	12,081	125	200	26,756	32,323	55,777	2,056	72,516	74,572	44,113	69
La	373	785	3,416	2,389	4,982	765	1,272	93,639	36,154	119,060	17,593	126,182	143,775	53,300	170
Ky	717	1,214	4,082	20,343	19,120	11,964	836	36,480	3,668	56,708	15,517	82,907	98,424	39,070	152
Tenn	290	1,563	815	16,651	16,149	2,993	3,175	85,447	10,437	106,759	8,242	129,278	137,520	120,450	14
South	**15,270**	**8,755**	**24,015**	**91,362**	**117,238**	**52,248**	**26,565**	**634,889**	**265,933**	**921,864**	**131,916**	**1,113,359**	**1,245,275**	**853,254**	**46**
Ohio	2,482	4,644	4,464	6,682	26,779	32,915	13,025	145,015	9,072	142,207	49,349	195,729	245,078	217,526	13
Ind	2,197	2,430	3,878	1,733	14,471	20,395	1,909	136,577	13,130	150,565	24,694	172,026	196,720	146,369	34
Ill.	2,413	3,555	7,576	3,078	21,755	40,443	13,589	128,318	11,032	120,635	58,086	173,673	231,759	210,304	10
Wis	1,020	2,215	1,370	315	16,306	22,246	4,139	58,035	3,477	54,777	27,657	81,466	109,123	49,233	122
Mich	679	1,293	2,337	355	8,941	9,106	3,974	94,775	4,490	84,752	16,556	109,394	125,950	119,510	5
Mid. West	**8,791**	**14,137**	**19,625**	**12,163**	**88,252**	**125,105**	**36,636**	**562,720**	**41,201**	**552,936**	**176,342**	**732,288**	**908,630**	**742,942**	**22**
Minn	1,149	3,192	3,279	2,107	18,979	3,144	1,500	31,402	9,123	33,476	6,784	67,091	73,875	33,816	118
Iowa	652	833	3,708	2,024	12,345	4,470	1,375	44,612	4,653	42,477	9,627	65,045	74,672	55,214	35
Mo	3,029	1,904	2,301	6,215	19,116	10,341	5,958	132,665	8,219	135,545	21,514	168,234	189,748	100,192	89
Ark	294	232	833	16,034	10,716	351	620	70,590	10,314	93,129	3,086	106,897	109,983	24,291	352
N. D.	52	83	136	.....	4,638	175	200	.....	1,316	.....	1,150	5,450	6,600	9,126	—28
S. D.	102	29	509	232	6,503	180	.....	1,117	1,262	494	1,029	8,905	9,934	7,096	40
Neb	460	952	619	1,611	7,548	782	3,050	9,326	3,773	9,922	6,239	21,882	28,121	32,139	—12
Kan	1,038	308	1,822	322	9,909	2,316	866	44,621	11,936	45,290	10,044	63,094	73,138	36,986	98
Okla	6,264	1,049	1,499	75	9,449	967	.....	63,706	28,883	86,977	4,547	107,345	111,892	35,422	216
Tex	6,312	7,841	5,647	12,382	58,295	43,995	26,120	320,599	104,721	382,930	86,823	499,089	585,912	292,642	100
Mont	306	198	1,454	666	5,792	330	1,023	531	2,031	1,481	1,614	10,717	12,331	19,293	—36
Wyo.	200	95	358	167	6,106	510	1,963	2,178	2,992	2,764	4,571	9,998	14,569	8,980	62
Colo	472	470	1,048	2,268	5,878	568	570	15,041	9,857	17,955	9,493	26,679	36,172	35,356	2
N. M	70	.....	54	66	3,757	432	.....	11,713	2,138	12,725	724	17,506	18,230	11,669	56
W. of Miss.	**20,400**	**17,186**	**23,267**	**44,169**	**179,031**	**68,560**	**43,245**	**748,101**	**201,218**	**865,165**	**167,245**	**1,177,932**	**1,345,177**	**702,222**	**92**
Idaho	218	270	373	10,989	2,987	2,192	160	2,689	3,503	13,825	4,217	19,164	23,381	7,168	226
Utah	715	1,016	96	497	5,625	560	.....	60,051	6,036	64,703	1,825	72,771	74,596	18,973	293
Ariz	715	595	477	1,829	5,340	500	1,500	12,466	13,760	25,133	3,189	33,993	37,182	26,090	42
Nev	222	190	.....	23	4,264	.....	600	23,180	2,750	25,573	1,053	30,176	31,229	6,801	360
Wash	2,356	619	925	9,431	9,498	3,835	6,109	61,247	47,965	96,787	19,878	122,107	141,985	95,811	48
Ore	782	549	513	6,184	8,912	2,665	230	26,240	18,928	46,536	5,931	59,072	65,003	30,202	115
Calif	5,926	6,496	4,234	39,397	16,305	48,238	85,088	150,134	117,353	255,465	160,026	313,145	473,171	308,303	53
Far West	**10,934**	**9,735**	**6,618**	**68,350**	**52,931**	**57,990**	**93,687**	**336,007**	**210,295**	**528,322**	**196,119**	**650,428**	**846,547**	**493,348**	**72**
U. S. 1941	**76,698**	**88,719**	**111,628**	**245,221**	**582,847**	**496,176**	**485,683**	**2,785,585**	**996,142**	**3,500,488**	**1,178,082**	**4,690,617**	**5,868,699**	.....	.....
U. S. 1940	69,704	91,467	130,151	234,285	678,172	594,064	400,171	1,196,257	602,972	1,451,726	**1,162,254**	**2,824,989**	.....	**3,907,243**	.....
% Gain '41 '40	**10**	**—3**	**—7**	**5**	**—14**	**—17**	**21**	**133**	**65**	**141**	**1.5**	**66**	.....	.....	**47**
Canada '41	**3,004**	**1,963**	**1,835**	**1,979**	**12,304**	**92,906**	**12,190**	**49,509**	**86,842**	.....	**122,248**	**140,284**	**262,532**	.....	.....
Canada '40	2,880	2,163	3,734	2,684	17,930	64,676	15,980	67,186	75,386	.....	**90,026**	**162,593**	.....	**252,619**	**4**

6. CLASSES AND LOCATION OF ENGINEERING CONSTRUCTION REPORTED BY *ENR*



privately-operated factories, $284,898,000 in federally-owned and operated plants, $274,181,000 in barracks, camps and cantonments, $194,315,000 in defense housing, and $394,826,000 in other military buildings.

Unclassified construction, which includes airports, airbases, shipyards and shipways, pipelines, communication lines, and other military and private installations so vital to the war effort, totaled $996,142,000, a gain of 65 percent over a year ago. Four-fifths of this unclassified volume was for direct defense construction.

Private industrial building, $496,176,000, dropped 16.5 percent below a year ago, but production facilities financed by federal funds, $1,363,673,000, brought total industrial expansion to $1,859,849,000 for 1941. Approximately half of the expansion volume, $892,573,000, was for plants in the chemical industries; $402,557,000 was for machine and machined-part plants; $276,773,000 for airplane and aircraft engine factories; $91,807,000 for metal refining and rolling mills; and $86,180,000 for public utilities.

Waterworks projects gain

Waterworks construction, $76,698,000, rose 10 percent over last year due primarily to $22,408,000 in awards in military and industrial defense areas. Earthwork and drainage, $245,221,000, climbed 4.5 percent above the preceding year as a result of the $80,139,000 for defense work. Commercial building and large-scale private housing, $485,683,000, the only other class of work to report a gain, was 21 percent higher than in 1940.

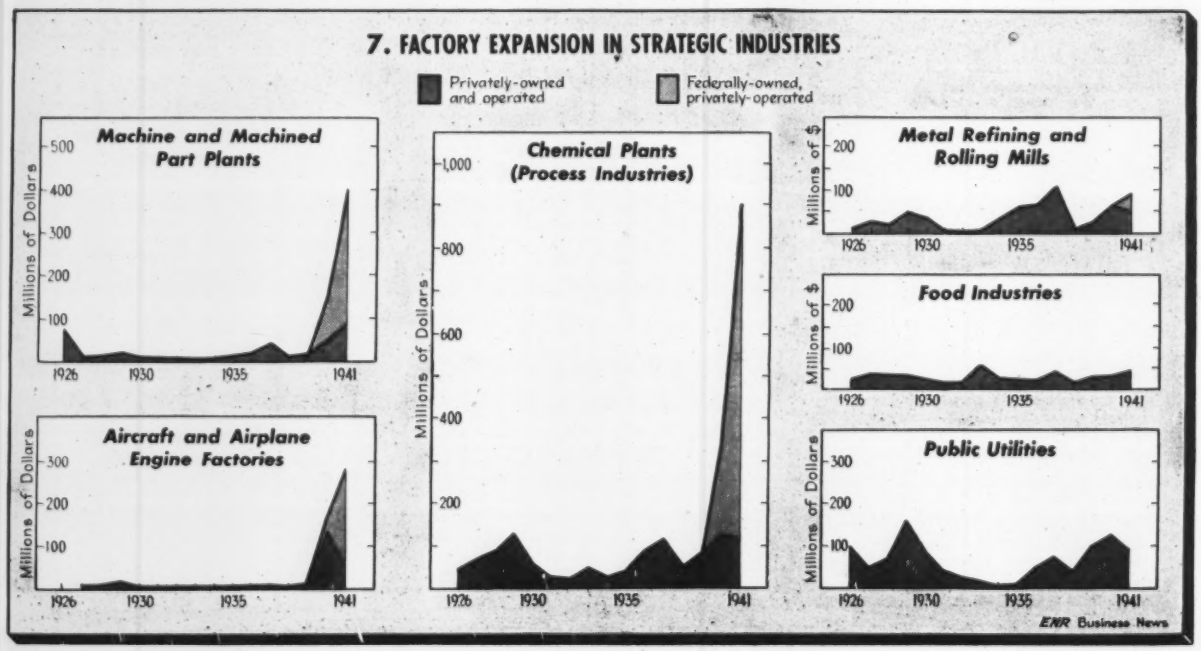
Street and road lettings decreased 14 percent from a year ago, and bridge construction was 7 percent lower. Sewerage awards were 3 percent under their last year's total despite the fact that $17,448,000 for defense projects were included in the volume.

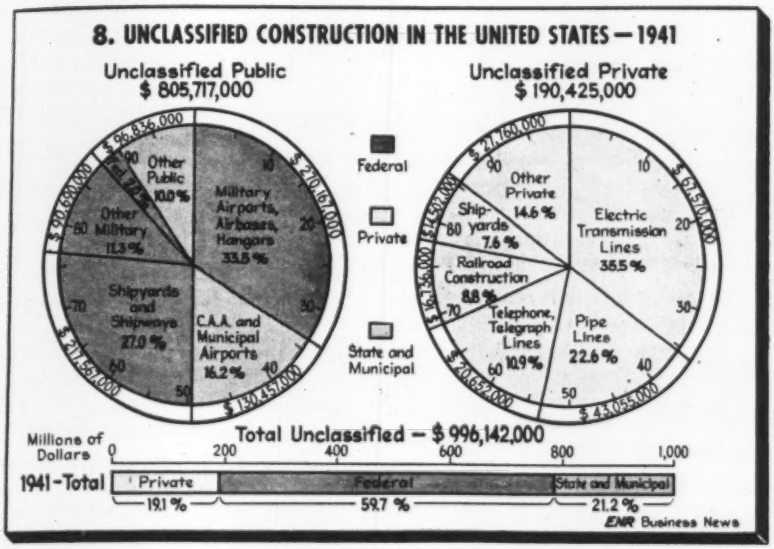
IV—CONTRACTS FOR PRIVATE INDUSTRIAL BUILDING CONSTRUCTION BY INDUSTRIES

(Value in Thousands of Dollars ENR Reports)

Transportation Service	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941 No.	1941 Value
1. Railroads						$1,108	$3,621	$909	$712	$1,690	$2,417	$2,546	$1,447	$1,827	29	$2,965
2. Automotive	$23,022	$37,181	$28,962	$18,090	$10,479	9,562	10,288	5,655	4,173	5,127	8,431	4,250	4,114	5,077	118	9,202
Public Utilities	43,860	64,373	151,033	86,137	40,813	22,800	14,290	1,741	7,577	42,481	70,765	37,658	94,822	121,155	93	86,180
Process Industries (a)	67,415	82,591	122,048	52,741	24,679	49,002	42,203	21,922	34,655	81,627	111,246	45,529	78,239	123,165	413	115,539
Food Industries (b)	30,827	32,957	32,138	21,289	14,311	14,385	50,038	20,674	19,655	28,639	36,248	13,838	23,049	28,292	382	34,263
Metal Refining and Rolling	26,847	19,014	48,920	34,083	3,515	745	6,979	31,609	59,075	65,505	111,426	8,590	22,340	66,390	67	52,636
Metal Working Plants																
1. Auto Factories*				6,380	3,120	3,735	331	1,709	3,553	17,410	21,763	2,665	1,562	5,535	30	2,980
2. Aircraft Factories	211	4,361	14,818	2,230	75	418	128	30	425	915	4,312	590	11,037	137,656	60	40,977
3. Foundries	2,852	4,752	4,150	2,146	1,686	188	465	368	1,952	1,541	1,890	335	1,819	2,050	32	2,235
4. Mach. and Mach. Parts (c)	6,985	11,503	17,044	6,374	6,639	5,220	2,848	3,404	11,079	14,560	41,030	8,757	14,343	48,446	613	93,965
Textiles (excluding rayon)	46,134	9,103	9,705	3,300	2,427	2,047	2,781	1,431	2,216	3,421	5,017	2,089	3,714	1,931	42	9,148
Wood Industries	3,204	2,652	4,857	1,400	726	595	2,296	488	999	1,008	825	480	950	2,890	41	2,672
Miscellaneous																
1. General Factories	65,670	75,989	110,311	87,274	53,181	12,646	14,618	14,752	26,118	45,344	61,511	23,760	24,744	49,065	577	42,634
2. Refrig'n. and Cold Storage	4,288	10,817	3,327	9,727	4,099	613	490	500	278	209	417	1,011	800	585	11	780
Total	$321,315	$355,187	$547,313	$331,171	$165,750	$93,064	$152,376	$105,192	$172,467	$309,477	$477,298	$152,098	$282,980	$594,064	2,508	$496,176

* Auto factories for years 1926, 1927, 1928 and 1929 are included under "Automotive"— Transportation Service.
(a) Includes Distilleries.
(b) Includes Breweries and Wineries.
(c) Includes Radio Plants.





All regions gain

Every section of the country reported substantial gains over 1940, and five of the six regions rose to new highs. West of the Mississippi, $1,345,177,000, climbed 92 percent over last year's peak; Southern awards, $1,245,275,000, were up 46 percent over the record of a year ago; Middle Atlantic, $1,211,361,000, rose 27 percent in the year to the highest total reported since 1930; Middle West, $908,630,000, gained 22 percent over 1940 and topped the 1928 peak by 12 percent; Far West, $846,547,000, was up 72 percent over the preceding year's high; and New England, $311,709,000, exceeded 1940 by 28 percent, and the former record of 1930 by 18 percent.

West of the Mississippi states led the nation with 22.9 percent of the total engineering construction for the year. The South was again a serious challenger, being responsible for 21.2 percent of the total. Then came Middle Atlantic, with 20.6 percent; Middle West, 15.5 percent; Far West 14.4 percent; and New England, 5.3 percent.

Residential building

Estimates of dwelling construction for 1941 stated that 615,000 new units were placed under construction in rural non-farm areas. This was the greatest number of units provided in any year since 1928 according to the Bureau of Labor Statistics, and it topped last year's total by 14 percent.

The 21 percent increase in one-family dwelling unit construction was responsible for the gain over 1940, as two-family and multi-family units were 11 and 14 percent lower, respectively, than a year ago.

Approximately 96,000 units, or 16 percent of the non-farm dwelling unit total, were publicly financed in 1941. Defense workers' and military personnel housing made up 76 percent of the public total, and USHA-financed non-defense projects made up the balance. In 1940, 73,533 units were publicly financed, of which 23,785 units were constructed for defense purposes.

Every section of the nation, excepting the Mountain states, registered housing gains over last year, and all city-size groups reported increases. The greater gains were reported in smaller-sized cities and rural non-farm areas, due to the emphasis on defense housing in new production, training base and military operations areas.

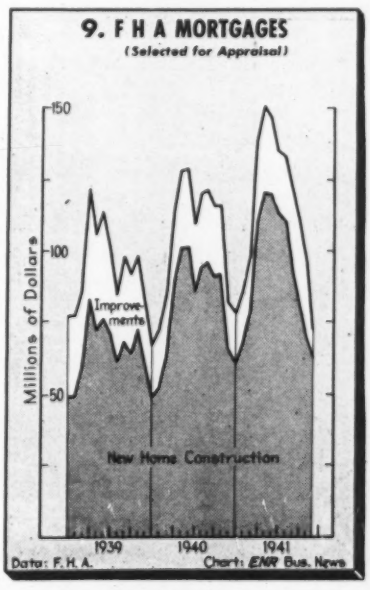
FHA mortgages selected for appraisal reached $1,400,000,000 for the year, up 10 percent compared with 1940. Of this mortgage volume, approximately $1,115,000,000 was for new home construction, 13 percent above the 1940 mark.

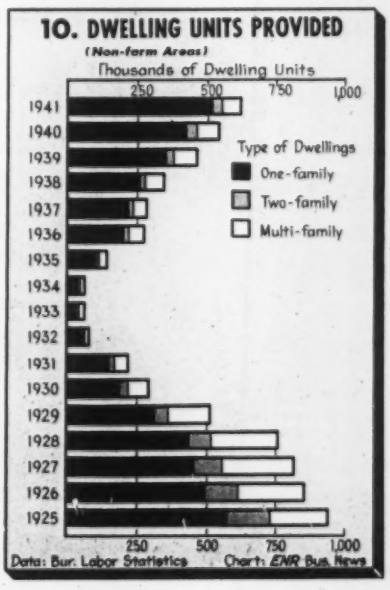
The share of mortgages for new home construction has risen steadily since 1938. In that year, 58 percent of the mortgage volume was for new building. In 1939 it rose to 70 percent; in 1940 to 78 percent; and in 1941 to 80 percent.

Building permits

Building permits issued during the first eleven months of 1941 were 9.6 percent higher than in the corresponding period last year and the peak volume since 1930 according to Dun and Bradstreet's records for 215 cities. All sections of the country except the Middle Atlantic and South Atlantic states reported gains over the 1940 period. The Pacific states and New England recorded the greatest increases, 41.1 and 20.2 percent higher, respectively, than in the preceding year's period.

The Bureau of Labor Statistics reported a 9.5 percent increase in total building permit valuations for the eleven-month period, with new residential building 16 percent higher; non-residential construction up 0.6 percent; and additions and alterations up 7.8 percent. These statistics are based on 2,142 reporting cities.





Employment and Materials

CONSTRUCTION EMPLOYMENT climbed sharply in 1941, increasing 35 percent over the preceding year according to Bureau of Labor Statistics estimates. This gain, based on ten-month figures, brought the current employment average to 1,804,000 men per month, just about on a par with the 1929 average of 1,806,000.

Employment in the construction field rose steadily during 1941 with the exception of a minor decrease in March. At the opening of the year it was estimated that 1,623,000 men were employed. The latest available figure, October, revealed 1,980,000 workers.

This 35 percent gain in construction employment compares with total employment in non-agricultural fields which averaged 38,594,000 men for the ten-month period, an 8 percent increase over 1940, and 6 percent higher than the 1929 level. In January, total employment was estimated to be 36,621,000 men. By October, with an unbroken rise during the intervening months, the figure reached 40,749,000.

Material shipments rise

Shipments of major construction materials were substantially higher than in 1940, reflecting the tremendous demands made on this phase of the construction industry by the defense program.

Fabricated structural steel shipments at the end of eleven months were up 52 percent compared with the total for the corresponding period last year, and were headed for the highest volume reported since 1928. Portland cement climbed 28 percent over the shipment total for the eleven-month period in 1940, and it is estimated that the total will reach 166,000,000 barrels for the whole of 1941, the highest volume since 1929.

Lumber shipments at the end of ten months increased 13 percent over the volume for the 1940 period. Production is expected to reach 30 billion board feet for the year, 13 percent over the preceding twelve-month total, and the highest peak in the past twelve years.

Asphalt prepared roofing shipments for the opening nine months were 31 percent higher than in the similar period last year.

Production of steel ingots for eleven months, 75,764,000 net tons, has already topped the record volume of a year ago, and a gain of 23 percent over the 1940 total is anticipated.

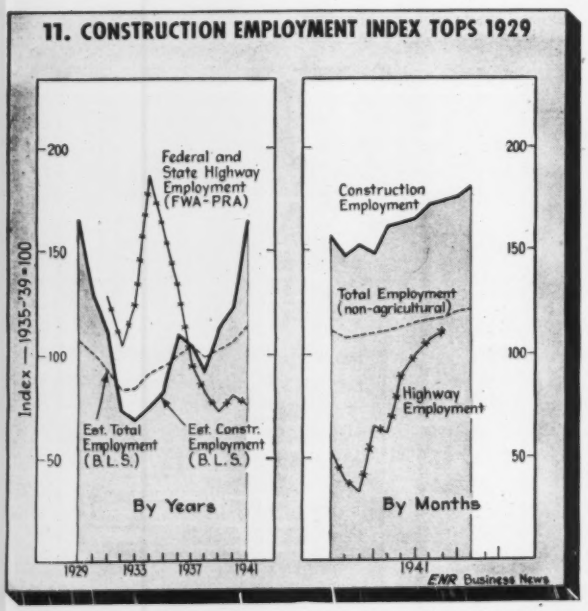
The Department of Commerce Index of construction material shipments, based on 1929 as 100, averaged 108.6 for the ten months of 1941, 23 percent above the same period last year.

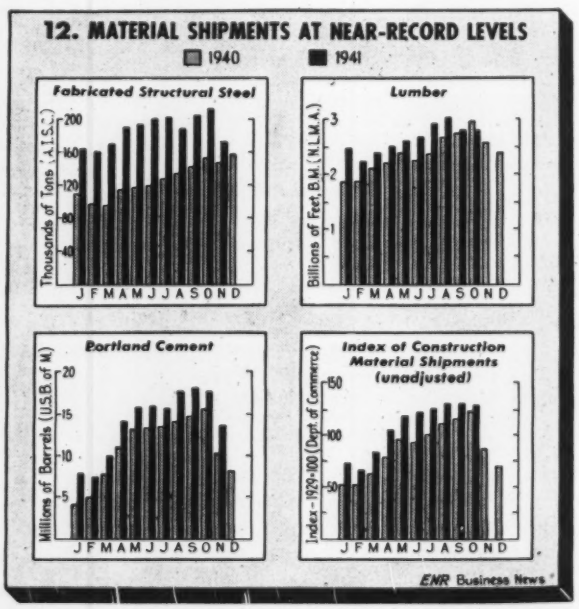
All indications at present are that war construction will take most of the available supply of construction materials in 1942, and materials will be hard for civilian users to obtain, except for a few restricted classes of work.

V—OUTPUT OF VARIOUS CONSTRUCTION MATERIALS FOR TEN-YEAR PERIOD

Item	Basis	Unit	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	% Change '40 to '41
Lumber	Production	Millions Bd. ft.	10,824	14,700	15,492	19,539	24,355	25,997	21,646	24,976	26,966	30,528	+13
Cement	Shipments	Thous. Bbl.	80,529	64,086	75,917	74,936	112,566	114,010	106,533	122,291	130,315	166,000	+28
Steel Ingots	Production	Thous. net Tons	14,922	25,305	28,671	37,428	52,425	55,443	31,071	51,585	66,982	82,560	+23
Fabricated Structural Steel	Shipments	Thous. Tons	942	828	1,033	1,095	1,548	1,660	1,159	1,440	1,516	2,264	+49
Fabricated Steel Plate	New Orders	Thous. Tons	† 162	198	242	258	484	429	285	357	†	†	
Explosives	Shipments	Thous. lb.	227,508	249,366	307,380	297,730	378,361	387,805	320,259	372,470	406,671	461,082	+13
Common Brick	Shipments	Millions	.....	.....	637	952	1,720	1,896	1,537	1,966	1,908	‡	
Vit. Paving Brick	Shipments	Thousands	.....	.....	87,216	62,528	96,001	79,716	84,887	68,439	56,116	39,200	−31
Prepared Roofing	Shipments	Thous. squares	23,220	24,732	24,000	26,052	32,237	29,942	34,610	34,144	32,706	37,500	+15

* Estimated Totals. † Temporarily discontinued. ‡ Not currently reported on comparable basis.




12. MATERIAL SHIPMENTS AT NEAR-RECORD LEVELS
1940
1941
Fabricated Structural Steel
Thousands of Tons (A.I.S.C.)
Lumber
Billions of Feet B.M. (N.L.M.A.)
Portland Cement
Millions of Barrels (U.S.B. of M.)
Index of Construction Material Shipments (unadjusted)
Index - 1929-100 (Dept. of Commerce)
J F M A M J J A S O N D
ENR Business News

Construction Costs

CONSTRUCTION COSTS continued upward in 1941 and increased 6.5 percent over the average for 1940 as measured by the *ENR* Construction Cost Index based on wage rate and material price rises alone. The index started the year at 249.69 and after a gradual climb stood at 252.40 in April, a rise of 1 percent. By the end of the year, however, it rose to 266.16, the highest value since June, 1920, and 7 percent over the value at the outset of 1941.

The lumber and common labor components were responsible for the increase as steel and cement cost factors in the index were unchanged. The lumber component was fairly stable during the first seven months of the year, with only minor month-to-month changes. From that point on, however, it climbed sharply and in December was 11 percent above the January, 1941 figure.

The common labor factor continued to rise steadily all during the year, and at the end of 1941 had climbed 8 percent over the opening month's value.

The *ENR* Building Cost Index average for 1941, 211.46, was up 4 percent over the preceding year. This index began the year at 207.94 and reached its peak value, 216.54 in November, then receded to 216.37 at the year end. The skilled labor component of the index rose 3.5 percent during the course of the year.

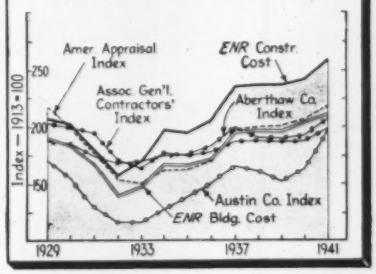
A comparison of the latest available values for *ENR* and three other general cost indexes with their respective December, 1940 figures (Table VI), revealed a similar trend for all. The only difference was in the size of the increase reported. The American Appraisal Co. and the Associated General Contractors Indexes were each up 5 percent, and the E. H. Boeckh Co. index for New York City was up 1 percent.

Contractors' indexes climbed more sharply than general cost indexes. These take into account invisible cost factors such as labor efficiency, increased overtime work, higher freight rates for longer shipping distances, and delayed deliveries. The Austin Co. Index rose 19 percent over the December, 1940 value. Aberthaw Co. Index was up 10 percent for the year; and in the eight months from December, 1940 to August, 1941, the Turner Co. Index increased 11 percent.

Construction wages rise

Common labor wage averages in the construction field reported by *ENR* for twenty cities began 1941 at 71.1c. per hour and rose almost steadily throughout the year, reaching 76.9c. in December. The result was a new record average hourly rate of 74.3c. per hour for 1941, an increase of 6.3 percent over the previous all-time high of last year.

14. BUILDING COST TRENDS



VI—CONSTRUCTION AND BUILDING COST INDEXES

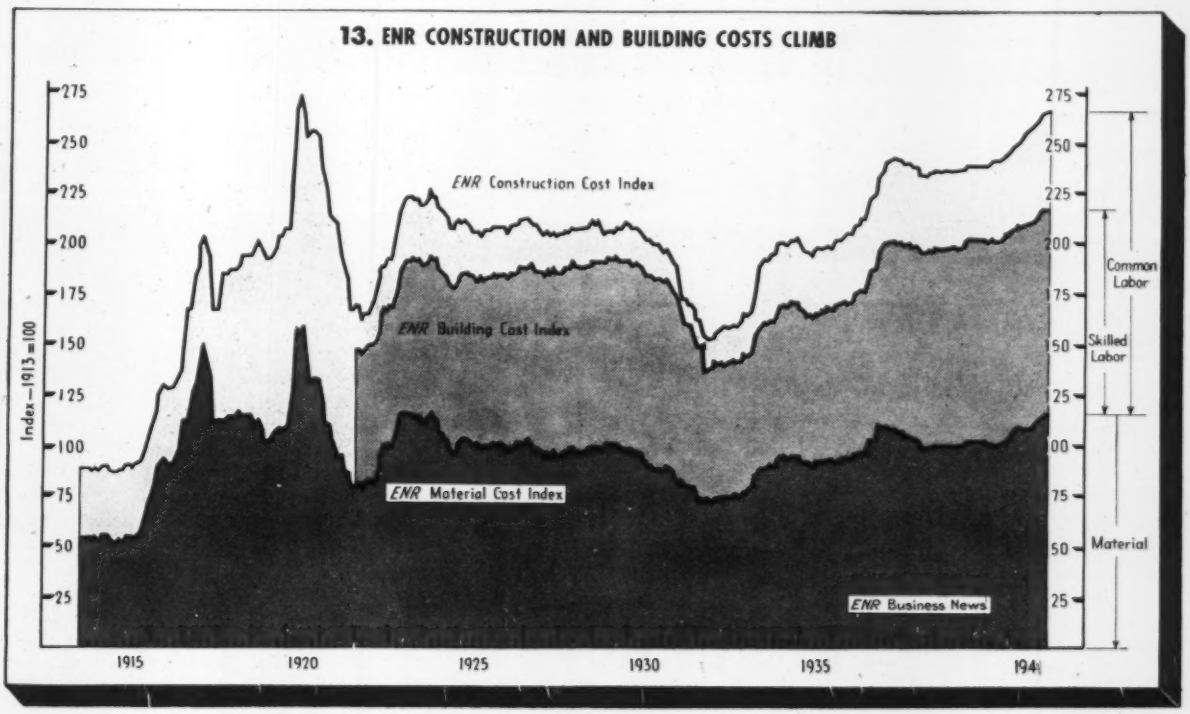
GENERAL INDEXES

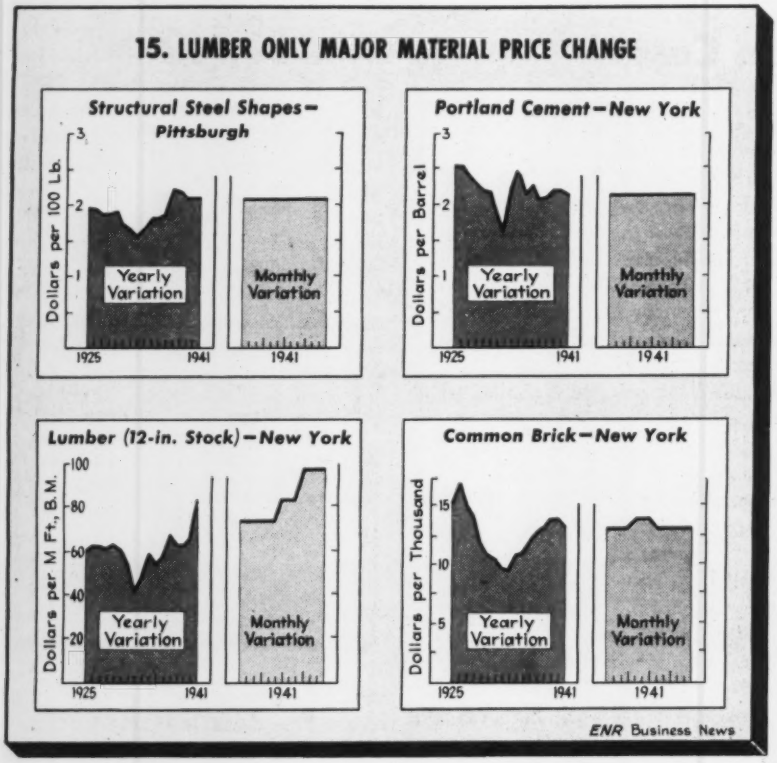
	Dec. 1940	Latest Available Index	% Increase
E N R Construction	250	268 (Jan.)	7
E N R Building	208	217 (Jan.)	4
Assoc. Gen. Contractors (Bldg.)	193	203 (Nov.)	5
American Appraisal Co. (Bldg.)	212	223 (Nov.)	5
E. H. Boeckh (Brick and Steel, New York)	254	257 (Dec.)	1

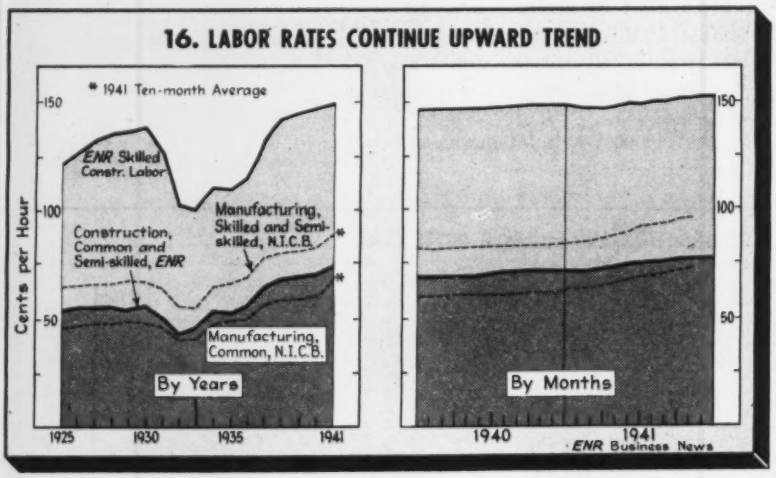
CONTRACTOR'S INDEXES

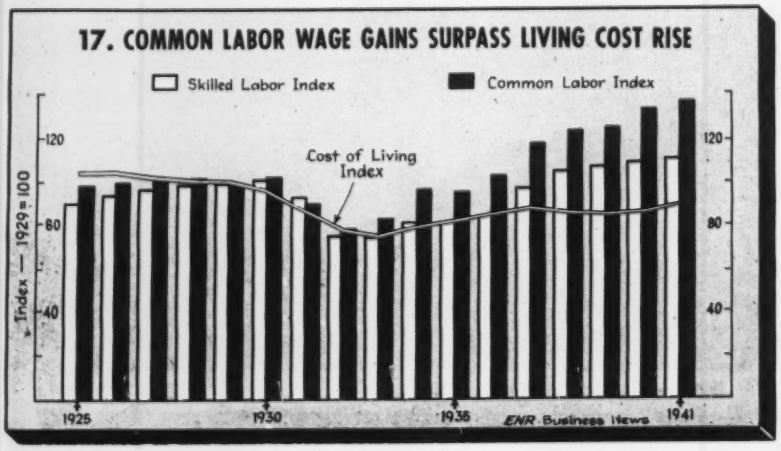
Aberthaw Co. (Bldg.)	195	215 (Dec.)	10
Turner Co. (Bldg.)	204	227 (Aug.)	11
Austin Co. (Bldg.)	172	205 (Dec.)	19

13. ENR CONSTRUCTION AND BUILDING COSTS CLIMB









The skilled construction average rate for twenty cities opened 1941 at $1.469 per hour, and with the exception of a slight decrease in March, and maintenance of previous month's levels in August, October and December, increased at a steady pace to $1.521 at the year's end.

The 1941 skilled labor average, $1.495, reached a new peak, 1.5 percent over the mark set in 1940.

The common and skilled labor wages in manufacturing, based on ten-month statistics, increased at a much faster pace than common or skilled labor in the construction field. Manufacturing common labor hourly rates gained 10 percent over 1940, and skilled hourly rates increased 9 percent according to the National Industrial Conference Board.

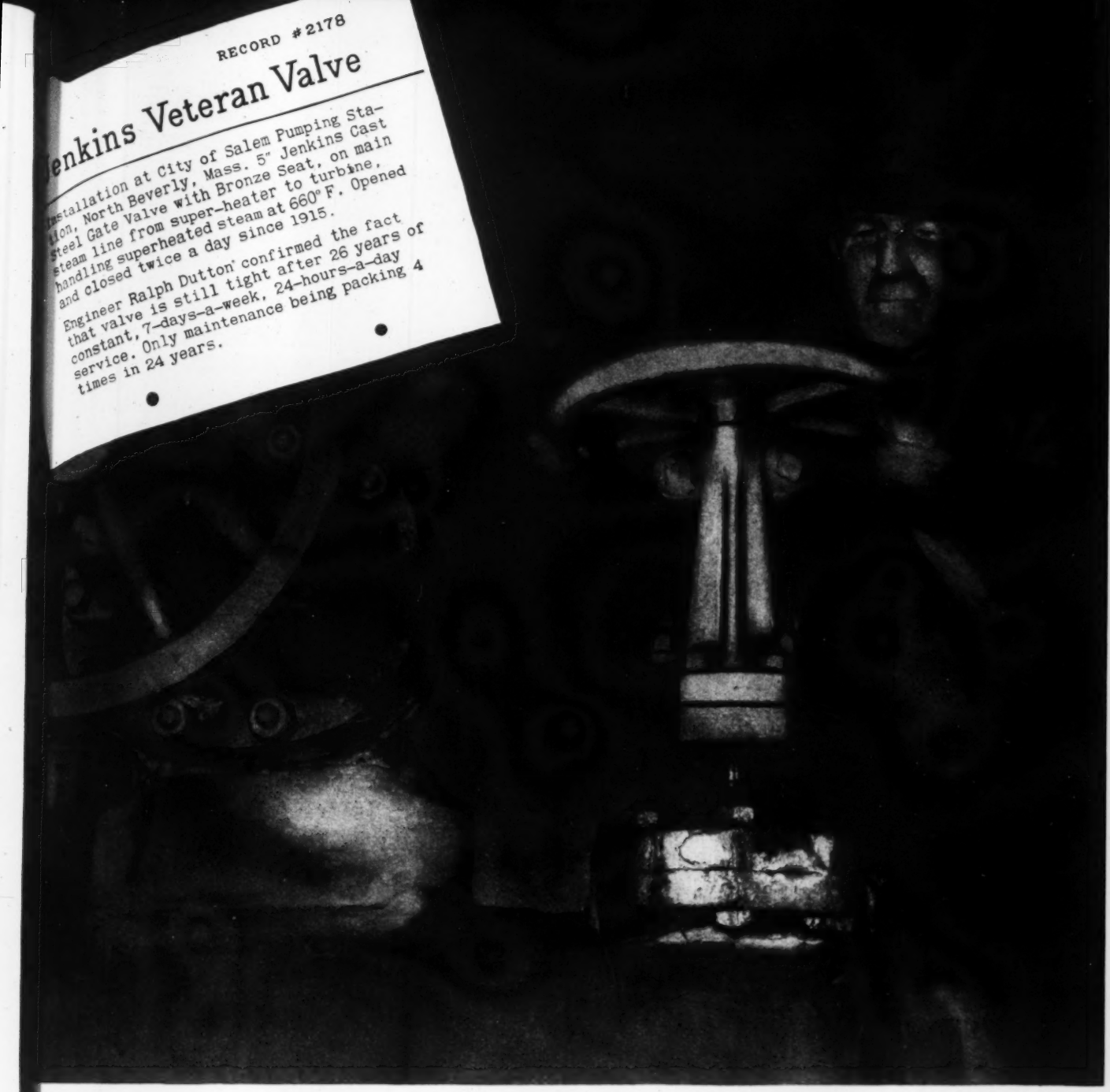
Real income, that is, actual wages in relation to living costs continued to improve for common construction labor, but the skilled workers' wage increases failed to offset the rise in the cost of living. The 1941 wage rate index for the construction industry, based on 1929 as 100, was 136.5 for common labor and 110 for skilled labor, gains of 6.3 and 1.5 percent, respectively, over last year. The Cost of Living Index computed by the N.I.C.B. increased 3.6 percent over a year ago.

Construction material prices

Construction material prices in New York, with the exception of lumber, remained fairly steady during 1941. Long leaf yellow pine opened the year at $72.50 per M ft., stayed at that level through May, then climbed to $82.50 in June, a price which held through August. In September, the price jumped to $97.50 and remained there for the balance of the year.

The structural steel base price remained unchanged throughout the year at $2.10 per 100-lb. The Portland cement quotation, $2.15 per barrel, not including cost of sacks, stayed at that level all during 1941, but it was 2.3 percent under the 1940 average.

Common brick opened the year at $13.00 per M, and with the exception of a price of $13.50 in May, June and July, remained at that level. Cast iron pipe prices, f.o.b. Delaware River foundries, were unchanged throughout the year at $49.00 per net ton.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MEETINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, N. Y., Jan. 21–23, 1942.

NATIONAL SAND & GRAVEL ASSN., 28th annual convention, Netherland Plaza Hotel, Cincinnati, Ohio, Jan. 28–30, 1942.

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, Nicollet Hotel, Minneapolis, Minn., Jan. 27–29.

NATIONAL CRUSHED STONE ASSOCIATION, 25th annual convention, Netherland Plaza Hotel, Cincinnati, Ohio, Feb. 2–4.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, 23rd annual convention, Olympic Hotel, Seattle, Wash., Feb. 16–19.

AMERICAN CONCRETE INSTITUTE, 38th annual convention, Palmer House, Chicago, Ill., Feb. 17–19.

AMERICAN ROAD BUILDERS ASSOCIATION, Peabody Hotel, Memphis, Tenn., March 2–6.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Palmer House, Chicago, March 17–19.

REGIONAL AND LOCAL MEETINGS

BUILDING CONTRACTORS ASSOCIATION OF NEW JERSEY, Elizabeth-Carteret Hotel, Elizabeth, N. J., Jan. 16.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF ONTARIO, annual meeting, Royal York Hotel, Toronto, Jan. 17.

PURDUE ROAD SCHOOL, 28th annual meeting, Purdue University, Lafayette, Ind., Jan. 19–22.

CANADIAN CONSTRUCTION ASSOCIATION, 24th annual meeting, Seignory Club, Lucerne, Que., Jan. 21–23.

OKLAHOMA SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Tulsa, Okla., Jan. 23–24.

WYOMING ENGINEERING SOCIETY, 23rd annual convention, Cheyenne, Wyo., Jan. 23–24.

KENTUCKY SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Lafayette Hotel, Lexington, Ky., Jan. 23–24.

TEXAS SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Beaumont, Tex., Jan. 24.

ILLINOIS SOCIETY OF ENGINEERS, annual meeting, East St. Louis, Ill., Jan. 29–31.

ANNUAL HIGHWAY ENGINEERING CONFERENCE, University of Utah, Salt Lake City, Utah, Feb. 2–6.

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PENNSYLVANIA, annual meeting and dinner, William Penn Hotel, Pittsburgh, Pa., Feb 4.

THE MOLES, annual award dinner and business meeting, Roosevelt Hotel, New York, Feb. 4.

NEW JERSEY SEWAGE WORKS ASSOCIATION, 27th annual meeting, Stacy-Trent Hotel, Trenton, N. J., Mar. 5–6.

TEXAS CONFERENCE ON SOIL MECHANICS, 5th annual meeting, University of Texas, Austin, Tex., Feb. 6–7.

MINNESOTA FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES, annual meeting, Nicollet Hotel, Minneapolis, Minn., Feb. 11–14.

OHIO SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Deshler-Wallick Hotel, Columbus, Ohio, Feb. 12–13.

SOUTHEASTERN STATE HIGHWAY OFFICIALS, first annual meeting, Grove Park Inn Hotel, Asheville, N. C., Feb. 12–13.

MICHIGAN HIGHWAY CONFERENCE, 28th annual meeting, University of Michigan, Ann Arbor, Mich., Feb. 18–20.

SOUTHERN SAFETY CONFERENCE, 4th annual meeting, Roosevelt Hotel, New Orleans, La., Feb. 22–24.

SOUTHWEST ROAD SHOW AND SCHOOL, The Coliseum, Wichita, Kansas, Feb. 24–27.

ASSOCIATION OF HIGHWAY OFFICIALS of the North Atlantic States, Hotel Benjamin Franklin, Philadelphia, Pa. Feb. 25–27.

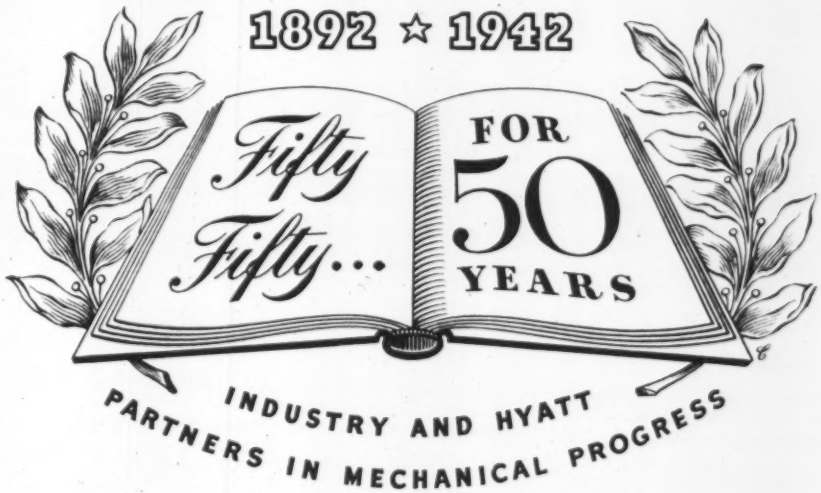
ELECTIONS AND ACTIVITIES

ERWIN HARSCH was elected president of the Chattanooga, Tenn., Engineers' Club at a meeting held the early part of last month. Mr. Harsch succeeds R. B. Bayston. Other officers elected were: W. E. Mosher, first vice president; R. B. Rougelot, second vice president; O. C. Kirkman, re-elected treasurer; W. G. Davies, re-elected secretary. A Christmas party was held by the club at the Hotel Patten.

L. O. STEWART, head of the civil engineering department at Iowa State College, has written a new vocational guidance book, "Career in Engineering", covering the needs of high school and junior college vocational counselors.

THE IOWA MASTER BUILDERS ASSOCIATION, at a two-day convention held at Des Moines, recently, adopted a resolution requesting the federal government to "save the building industry" by lifting priority rulings on steel, copper and similar building materials. H. L. Barquist, of Des Moines, who is executive secretary, explained that the 100 mem-

THANKS, INDUSTRY!



WE'VE COME A LONG WAY TOGETHER during the past fifty years. We've helped America through emergencies... and through the greatest industrial era in her history. We've brought the advantages of anti-friction roller bearings to the many new and perplexing mechanisms of industrial pioneers. The accomplishments have been great, the rewards rich . . . for Industry, for Hyatt, for America!

Inventive genius and engineering talent have guided us through the years... the experiences of one have helped and improved the other. Many design problems have been solved. Many application handicaps have been overcome. We've shown each other many new, better ways of doing things.

Today, on our 50th Anniversary, we feel gratified that you are placing Hyatts in machinery and equipment of all kinds...in factory and field, on highway and railway, in war and peace-time assignments . . . that you are calling upon Hyatt and Hyatt Roller Bearings, more than ever before, to help in upholding the excellence of your regular products and the products you are building for Victory.

For this confidence, again we say . . . THANKS, INDUSTRY. Hyatt aims to keep pace with you into the future—America's future—building the very best that seasoned experience and fresh imagination can produce. So let's set our sights on tomorrow... let's keep going "Fifty-fifty for 50 years" ... and more!

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

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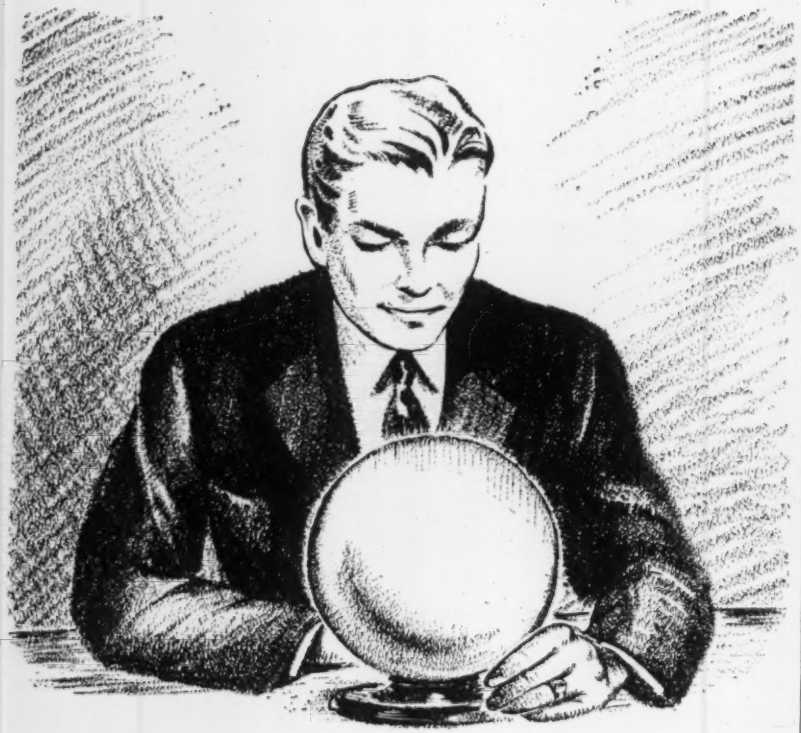


What's in the **FUTURE?**

We wish we could find a reliable crystal ball to tell us. But this we know—and it doesn't require a crystal ball to see. The time will come when Uncle Sam will say to us, "Well, boys, the nightmare is over. We don't need you any more. Now run along, and 'tend to your own knitting." *

Until that time, our ability to serve you is necessarily limited by the demands of our war efforts.

But when that time comes (and may it come soon), will you please remember that we have even increased our skill in designing and building the kind of centrifugal pumps that have made Morris installations win high praise and repeat orders in every industry.

*** Making centrifugal pumps and hydraulic dredges—the best in the world, we think.**

MORRIS MACHINE WORKS — MORRIS ESTABLISHED 1864 — BALDWINSVILLE NEW YORK

CENTRIFUGAL PUMPS

bers present did not wish to interfere with defense work, but felt that the building industry should be given advantage of any surplus of these basic materials not absorbed by defense needs. O. F. Paulson, Cedar Rapids, Iowa, was elected president succeeding E. W. Lippert, Boone, Iowa. Other officers elected were: J. Peter Olesen, Waterloo, Iowa, vice president; R. W. Scott, Albert Lea, Minn., secretary; W. F. Kucharo, Des Moines, treasurer, and Paul McCorkle, Sac City, Iowa, members of the board of directors.

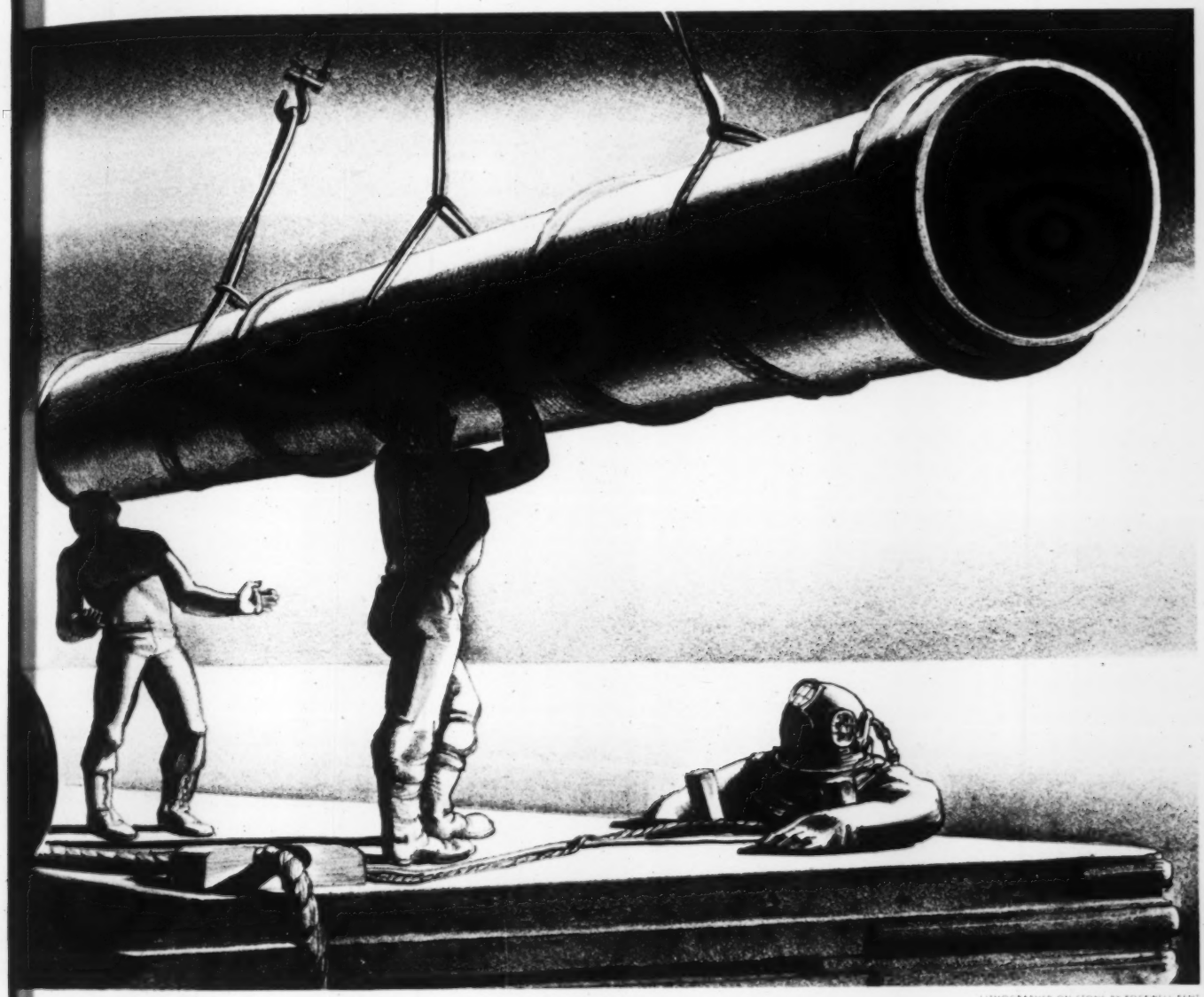
C. M. STANLEY, of Muscatine, Iowa, has been elected president of the Tri-City section of the American Society of Civil Engineers. Other officers are J. V. Hummber, Davenport, vice president; F. L. Flynt, Rock Island, secretary and treasurer.

ENGINEERING and national defense was the theme of the annual meeting of the Indiana Engineering Council and Indiana Society of Professional Engineers, holding a joint meeting at Indianapolis late last month. Participating organizations were: Indiana Section, American Society of Civil Engineers, Central Indiana Section, and Fort Wayne Section, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and Fort Wayne, Indiana Engineers Club.

An interesting feature of the meeting was an address at the annual banquet given by Maj. Francis J. Wilson, of the U. S. Army Office of Chief Engineers in Washington, on the subject of "Air Raids and Protective Construction." He illustrated his address with lantern slides of actual bomb damage in England. Col. Henry Hutchings of the U. S. Engineers discussed "The Engineering Profession and the National Emergency." A. A. Potter, dean of engineering at Purdue University, spoke on "Defense Training in Engineering, Science and Management."

Howard S. Morse, vice president and general manager of the Indianapolis Water Co., and Prof. Charles A. Ellis, of the structural engineering department of Purdue University, were presented life membership certificates in the Indiana section of the American Society of Civil Engineers. Col. C. E. Chatfield of Indianapolis was elected president of the Indiana Engineering Council. He succeeds W. A. Knapp of Purdue University. J. V. Smythe of the Indiana State Highway Commission was elected vice-president.

"CONSERVATION of natural resources, with special reference to post-war planning," was the subject of a special meeting of the Toronto branch of the Engineering Institute of Canada, last month. The meeting was attended by about 400 members, friends and guests. Prof. A. F.



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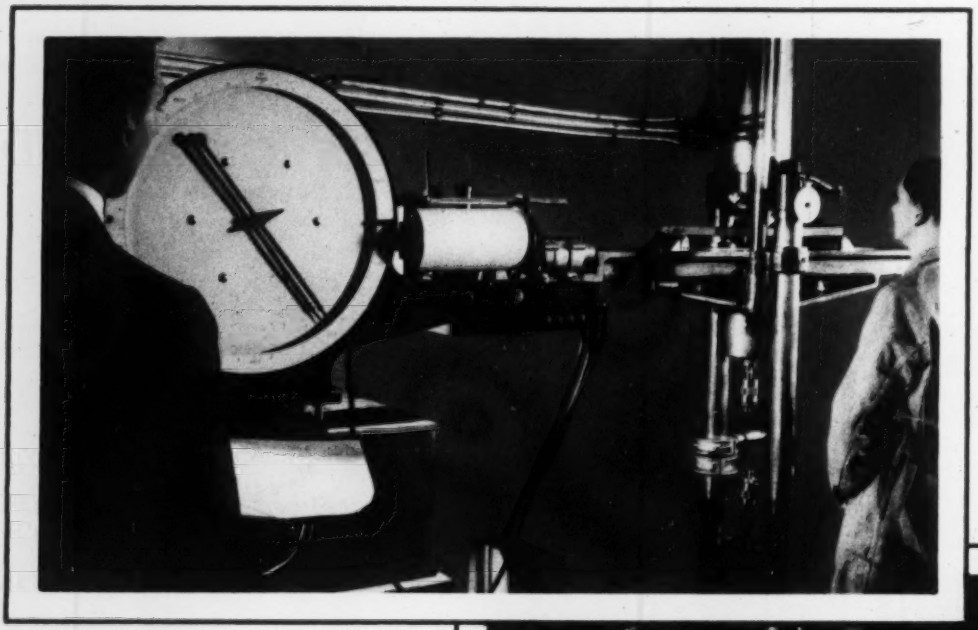

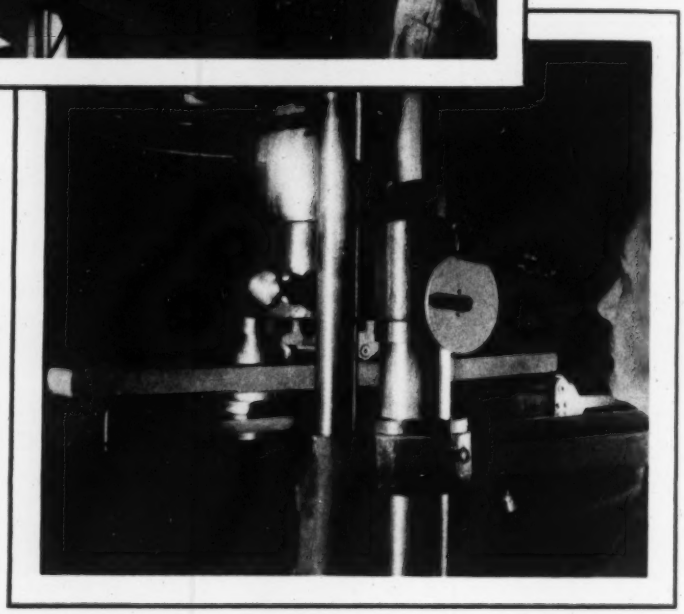

* The "2-inch by 1-inch Test Bar Test," illustrated above, is an acceptance test for cast iron pipe. The breaking load and deflection of the bar, which indicate the physical characteristics of the metal, are determined from this test. It is one of the routine tests made by this Company to insure that the quality of its pipe meets or exceeds the requirements of accepted standard specifications for cast iron pipe.

*** One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.**

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cast iron
PIPE

Centrifugally or Pit Cast for water, gas, sewerage, drainage and industrial services.

Coventry spoke on the water situation in southern Ontario, which is now critical, after F. A. MacDougall, deputy minister of forests for Ontario, had described in general terms the forestry situation in Ontario with relation to surface water. Dr. A. E. Berry, past chairman of the branch, spoke on public health in Ontario, in relation to conservation of natural resources, stressing the dangers of pollution of water supplies and the hazards of flooding. Prof. R. F. Legget introduced the speakers and exhibited the film "The River", loaned for the occasion by the U. S. Soil Conservation Bureau.

ZINT WYANT was elected president of the Topeka, Kan., Engineers Club at its recent annual meeting at Topeka. Other officers elected include: H. P. Brooks, first vice-president; C. Frank Virr, second vice-president; G. Dorr Pelton, secretary; J. Carl Law, treasurer; and Dale Neeley, assistant secretary.

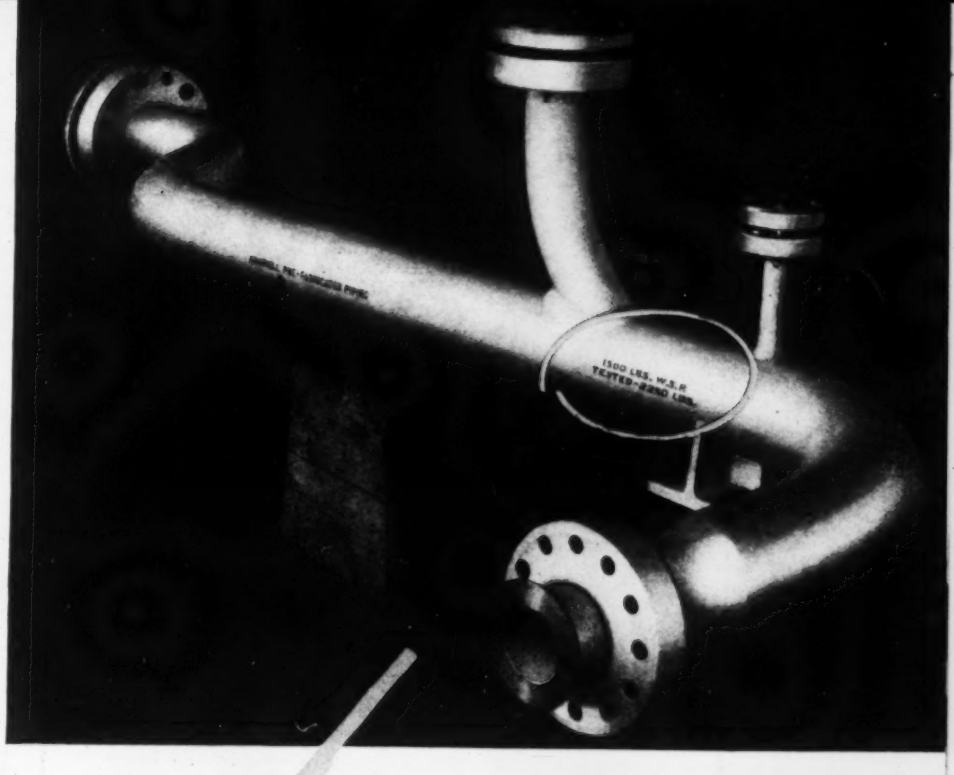
MEMBERS of the Panhandle Chapter of the West Virginia Society of Professional Engineers were guests of the Baltimore & Ohio Railroad recently at Washington, Pa. J. W. Wynn is president of the Panhandle Chapter. A demonstration of the centralized traffic control system of the B&O was given by J. P. Buzzerd, signal supervisor of the Pittsburgh office of the B&O. He was assisted by H. J. Piper, signal maintainer of the Pittsburgh office, and Thomas Lodge, dispatcher. Following the demonstration the party was entertained with a luncheon at the Washington Hotel.

THE COLUMBUS BRANCH of the Ohio Society of Professional Engineers met at Ohio State University in Dec. Charles J. Belz, head of the civil engineering department at the University of Dayton, was the principal speaker, and his subject was "Professionalism vs Unionism for the Professional Engineer."

AT A DINNER MEETING Dec. 4 in Cheyenne, Wyo., the Cheyenne Engineers' Club elected the following officers to serve for 1942: President, George T. Cunningham, plant engineer for the Mountain States Telephone & Telegraph Co.; vice-president, Kirby H. Olds, of the Wyoming State Highway Department; secretary-treasurer, John F. LaSasso of the Cheyenne Light, Fuel & Power Co.

W. O. JONES, director of public works for the city of Fort Worth, Tex., has been elected to membership in the American Public Works Association. A.P.W. is a service organization for engineers and administrative officers in the public works field with a membership of more than 1000.

AN ACCREDITED RATING from the Engineers Council for Professional Develop-



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This piece of Grinnell Prefabricated Piping and the barrel of a high power rifle both have to take the terrific punishment of extremely high pressures.

90° bends, curved angle nozzle, lap joint, integral swedged reducer – practically everything that can be done with a piece of pipe is represented in this piece which successfully passed every test under pressure of *more than one ton per square inch!*

Making a piece of piping to specifications like that is a large order, but it is an order that Grinnell takes in its stride. For Grinnell is equipped to interpret any piping requirement and prefabricate the piping accordingly.

When piping is involved, simply *"Give the plans to Grinnell"*. Grinnell Company, Inc. Executive Offices, Providence, R. I. Branch offices in principal cities.

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WHENEVER PIPING IS USED FOR DEFENSE

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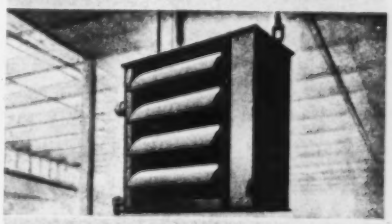
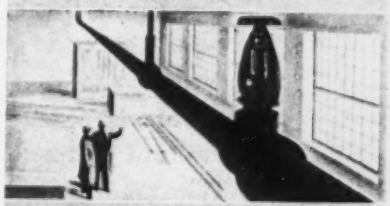
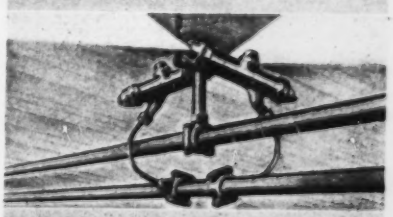
Grinnell Pipe Fittings make stronger, tighter pipe connections . . .



Grinnell Thermoliers provide heat when and where it's wanted at lowest cost . . .



Grinnell Automatic Sprinklers guard against fire, and husband precious defense efforts . . .



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Carey Built-Up Roof
Applied by Bert Tucker, Waterloo, Iowa

• The new exchange addition of the Northwestern Bell Telephone Company, Waterloo, Iowa, is protected by a CAREY Built-Up Roof, bonded for 20 years of trouble-free service.

A study of the records of thousands of CAREY Built-Up Roofs shows that many are still on the job after 25, 30, 35, some even 40 years, of service. The life of this roof, therefore, by the law of averages, should extend well beyond its bonded period.

This is extra value you get in CAREY Roofs without extra cost. For details, address Dept. 30. Whatever your roof needs,

put them up to **Carey** *for* **VALUE** + *plus*

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Dependable Products Since 1873
IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.

ment has been awarded the Vanderbilt School of Engineering at Nashville, Tenn., for its curricula in civil, electrical and mechanical engineering. Fred J. Lewis is dean of the school.

L. D. HOWARD, manager of the South Dakota Highway Planning Survey, was elected president of the South Dakota Society of Engineers and Architects at the organization's recent annual meeting. Mr. Howard succeeds Ralph Reed, Watertown, who was elected vice-president, succeeding W. S. Hannan, Pierre. Jesse C. Robinson, Pierre, was re-elected secretary-treasurer. New members of the council are Eugene Meeker, state highway engineer, Pierre; W. H. Gamble, professor of electrical engineering at South Dakota State College, Brookings; H. M. Pierce, city engineer, Huron; and W. R. Edgington, state WPA engineer, Mitchell.

AT THE 27TH ANNUAL MEETING of the Associated Contractors of South Dakota, George Douthit, of Sioux Falls, was re-elected president. The meeting was held the latter part of December at Rapid City, S. D. Other officers of the organization who were re-elected include: Henry H. Hackett, Rapid City, vice-president; Herman Claus, Sioux Falls, treasurer, and Arthur Boyce, Sioux Falls, secretary. Gust Jacobson, of Huron, was elected a director.

THE NORTH TEXAS chapter of the Texas Society of Professional Engineers, meeting at an organization session in Dallas last month, elected E. L. Meyers president, C. W. Miller, vice-president, Elgin Robertson, secretary-treasurer. Directors elected are: T. E. Huffman, H. C. Hammer, T. D. Thomas, W. H. Bolka and O. A. Koch. There were 56 charter members presented with credentials by John Miller, Austin, Texas, president of the Texas Society of Professional Engineers.

THE SAN FRANCISCO Section, American Society of Civil Engineers, at the annual meeting held the middle of last month elected the following officers for 1942: president, Frank E. Bonner; first vice-president, Samuel B. Morris; second vice-president, T. J. Corwin.

ASSOCIATED PENNSYLVANIA CONSTRUCTORS, meeting recently at Harrisburg, Pa., elected the following officers: James J. Skelley, of Media, president to serve until 1943; vice-president, H. D. Maxwell, Jr., of Luzerne; treasurer, A. Harden Koon, of Luzerne; chairman of the executive committee, W. C. M. Butler, of Hazleton; executive secretary, A. E. O'Brien, of Harrisburg; member of the board of governors, Roy W. Smith, of Dillsburg. Regional vice-presidents elected were: W. L. Dunn, of Cochranton; Alex Bailey, of Phillipsburg; Benjamin Banks, of Wilkes-Barre; Frank Jukurin, of Wilmerding; S. Howard

ATHEY *Announces the*

FORCE-FEED LOADER . . .

for Highway Maintenance and Construction

Now, you can salvage material from road or street construction—and use it to good advantage elsewhere. That's the job the new Athey Force-Feed Loader does. Pulled by a motor grader, truck or tractor, this efficient unit scoops up wide windrows of earth, or other material, left on the road surface in grading or maintaining operations and conveys it into a truck which is loaded "on the move".

Thus, valuable material is saved for use in filling low places, for widening or resurfacing other roads, for slope trimming, for loading of top soil, stockpile loading, for landscaping, and many other uses. And drainage ditches can easily be cleaned of washed-in materials with this handy Athey loader.

The operation of the Force-Feed Loader is fast, simple and thorough. A gasoline engine drives the floating-feeder blades and conveyor, provides ample power to move dirt, rocks, brush, and other types of materials, quickly and economically.

Get further information on either the Tow-type or the Self-Propelled Force-Feed Loader—use the coupon below which, of course, incurs no obligation.

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We will gladly send you, without cost, an illustrated and descriptive folder showing the Force-Feed Loader at work on a variety of jobs. Just send in the coupon at the right.

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Please send me the new Force-Feed Loader folder.

We are interested in the Force-Feed Loader for th following uses:_____

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Carey Built-Up Roof
Applied by Bert Tucker, Waterloo, Iowa

• The new exchange addition of
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years of trouble-free service.

A study of the records of thou
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The life of this roof, therefore, by
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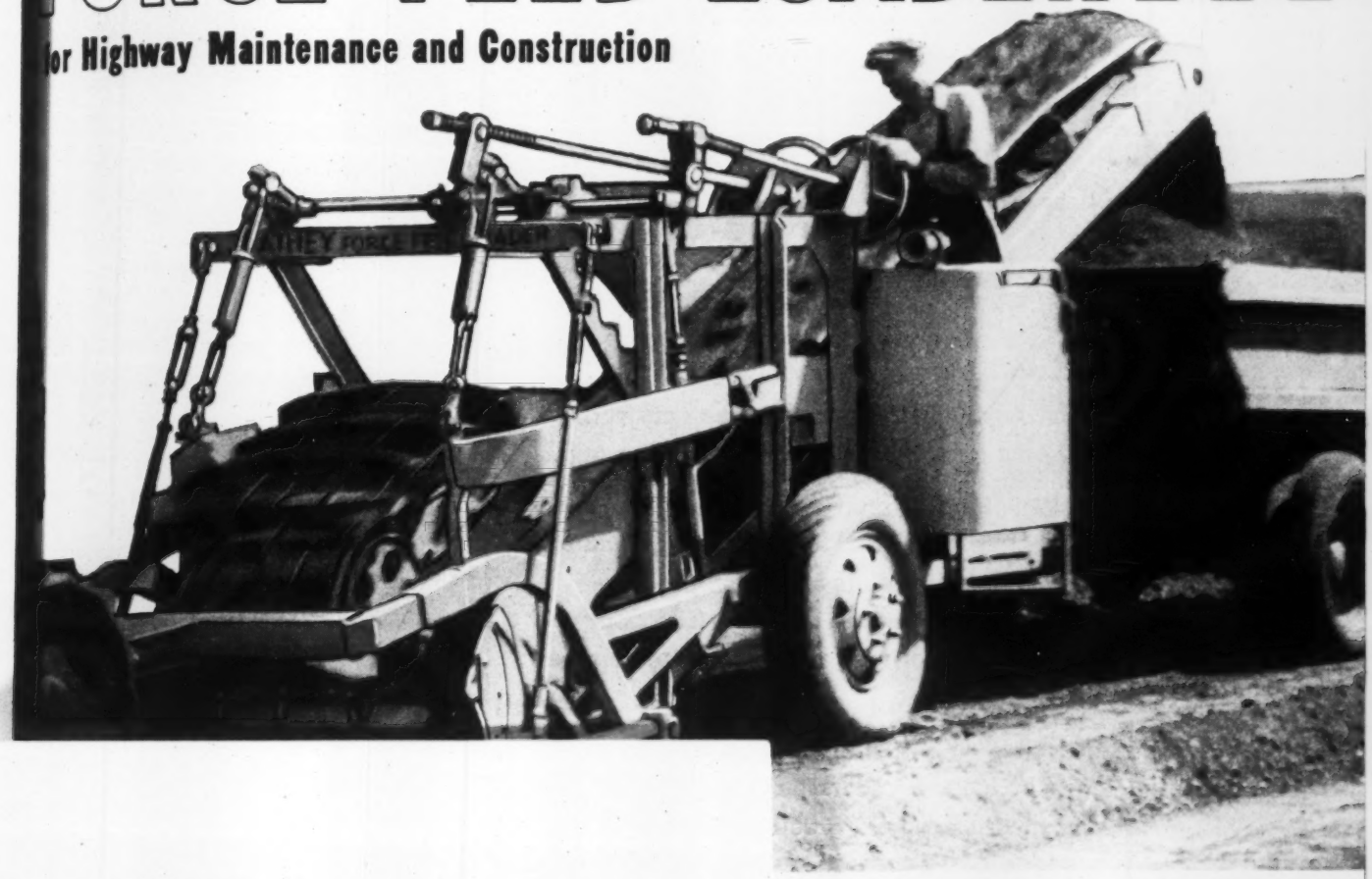
ATHEY *Announces the*

FORCE-FEED LOADER . . .

for Highway Maintenance and Construction



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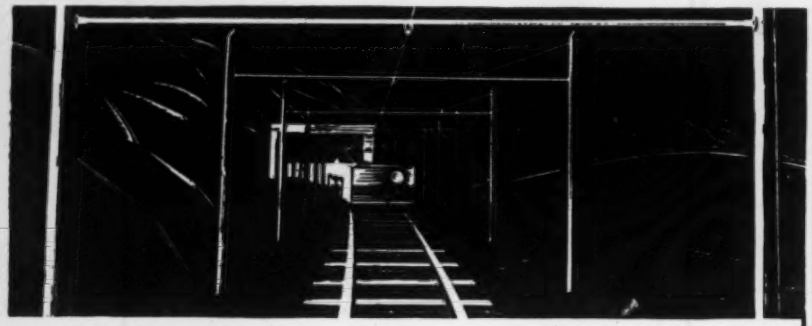

They Found Something Here You Should Know About

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WOLMANIZED LUMBER is ordinary wood that has been made highly resistant to decay and termite attack. Vacuum-pressure impregnation with Wolman Salts* preservative, under exacting technical control, does the trick. Service records covering millions of feet of Wolmanized Lumber are evidence of its durability.

MANY JOBS can be done best with wood; it is light, strong, resilient; it goes up easier and faster, and it costs less. With Wolmanized Lumber, you greatly lengthen the life of the construction. That's why it has been selected for so many of the tough jobs in industry. Wolmanized Lumber is handled just like ordinary wood. It is clean, odorless, and it can be painted.

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Brown, of Lebanon, and John Kelley of Philadelphia.

ERNEST BROWN, dean of the faculty of engineering at McGill University, Montreal, Canada, has been presented with an honorary degree of Doctor of Engineering from the University of Toronto. Dean Brown is a graduate of the University of Liverpool, and has been on the staff of McGill University since 1905; he was appointed Dean in 1928.

THE COLORADO SECTION of the American Society of Civil Engineers at their recent annual meeting at Denver, conferred life membership upon three outstanding Colorado engineers. They are, J. C. Fitterer, professor of civil engineering at the Colorado School of Mines, at Golden, Colo.; Frank Ray, city engineer of Colorado Springs, and John L. Savage, chief designing engineer of the Bureau of Reclamation. Mr. Savage was not present to receive the honor as he is now in Australia serving as a consultant to the British engineers.

BERRY E. BREVIK, structural engineer for the Portland Cement Association of Milwaukee, Wis., was elected president of the Wisconsin section of the American Society of Civil Engineers at its recent annual meeting in Milwaukee. Other officers elected were: First vice-president, Herbert H. Brown, superintendent of the Milwaukee waterworks; second vice-president, Arthur L. Boley, city engineer, of Sheboygan, and secretary-treasurer, Lloyd D. Knapp, special assistant city engineer, of Milwaukee.

THE CAROLINAS BRANCH of Associated General Contractors of America, at its 21st annual convention at Raleigh, N. C., last month elected Collier Cobb, Jr. of Chapel Hill, president for 1942. Other officers elected were: C. P. Street of Charlotte, N. C., vice-president; T. M. Seawell, of Charlotte, treasurer, and Frank H. Conner of Charlotte, acting executive secretary. Among the outstanding speakers at the convention were M. W. Watson of Topeka, Kan., national president of the Associated General Contractors of America, Inc.; C. Henri Rush, of Washington, D. C., principal priorities specialist in the OPM.

NEW OFFICERS for the Central Ohio Section of the American Society of Civil Engineers were installed recently by J. C. Prior, professor of Ohio State University. The new officers are: C. A. Allen, acting chief engineer of tests, Ohio State Highway Department, president; D. T. Mitchell, engineer in charge of sewer construction and maintenance for the city of Columbus, first vice-president; Alvin Tallmadge, sttructural engineer, second vice-president; and Guy H. Elbin, bridge engineer in the Franklin County engineer's office, secretary-treasurer.

MANHATTAN MAKES *arteries* FOR AIRCRAFT

—— *arteries that do not harden in desert heat or stratosphere cold*

BACK of throttle and pedal and instrument panel, a maze of hose made of oil- and gasoline-proof synthetic materials, leads out to wing flap and propeller blade, to rudder and landing gear, to gas line and bomb door, to vital mechanisms that must give instant response to controls.

In them flow the fluids for flying—and landing.

No simple tubing—these arteries that must and *do* stand up to rapid vibrations and extreme pulsations of pressure; to hot engine oil on the inside, sub-zero cold on the outside; to sudden and terrific alternations of stresses and temperatures.

That kind of stamina is an achievement of protracted, progressive and intense research.

But ships must land as well as fly—and then *stop*—quickly, smoothly.

For this vital need, MANHATTAN developed light, high-friction asbestos brake linings for all types of ships from light pursuit to giant bombers and airliners.

Many other highly specialized developments in natural and synthetic rubber are imperative to the aviation needs of the Defense Program, to which MANHATTAN'S resources, manpower and fifty years' experience are dedicated.

MANHATTAN PRODUCTS
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- Hose for Fuel and Oil Lines and Hydraulic Controls
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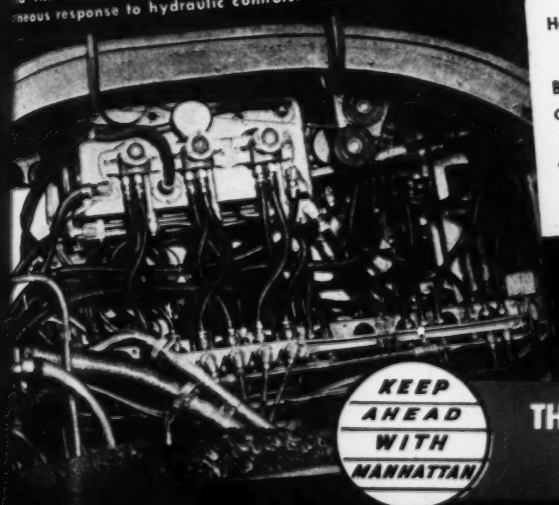
- Air, Welding & Paint Spray Hose
- Brake Cylinder Cups
- Hydraulic Packings
- Vibration Dampeners
- Molded Parts and Gaskets
- Radio Shielding Tubing
- Abrasive Wheels
- Non-slip Matting
- Transmission Belts
- Conveyor Belts

hind the instrument panel—Hose developed by Manhattan d The Weatherhead Company engineers assures instan- neous response to hydraulic controls.



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THE MANHATTAN RUBBER MANUFACTURING DIVISION
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EXECUTIVE OFFICES and FACTORIES . . . PASSAIC, NEW JERSEY

More Speed

"TIME IS SHORT." So reads the sober reminder posted in a thousand busy defense plants from coast to coast. Engineers and contractors on defense work don't need to be told. They've been giving time a licking ever since America began to prepare.

Now they've got a new ally in their battle. Already the "Caterpillar" Diesel DW-10 Tractor is speeding up defense on a growing list of jobs.

Designed and built from the ground up for long, fast, heavy hauling, this unit is doing all that was expected of it, and more! It has the husky, economical power of a 98-hp. "Caterpillar" Diesel Engine. "Finger-tip" steering. "High-traction" differential. Short turning radius. Full floating seat. Heavy-duty constant mesh transmission. Five speeds forward. High clearance. Scientific weight distribution that gives super-traction for every use.

The "Caterpillar" Diesel DW-10 Tractor is amply powered to handle a big payload at 18 miles an hour. And it has all the advantages of simple, rugged, dependable "Caterpillar" construction, through and through.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

FOR VICTORY — *Our armed forces have first call on "Caterpillar" production. We thank customers who have suffered delivery delays by giving clear right-of-way to our Victory efforts.*

Some of the defense jobs where "Caterpillar" Diesel DW-10 Tractors are setting records for speed and economy are:

Fort Worth Bomber Plant, 4 units; Twin City Ordnance Plant, 10 units; Mississippi Ordnance Plant, 10 units; Lauderdale Airport, Mississippi, 4 units; Bermuda Base Construction, 16 units; Merced Airport, California, 3 units; Denver-Cheyenne Defense Highway, 3 units; Des Moines Arms Plant, 8 units.

CATERPILLAR

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Diesel

ENGINES AND ELECTRIC SETS
TRACK-TYPE TRACTORS
WHEEL TRACTORS • ROAD MACHINERY

:OR THE DEFENSE JOBS!

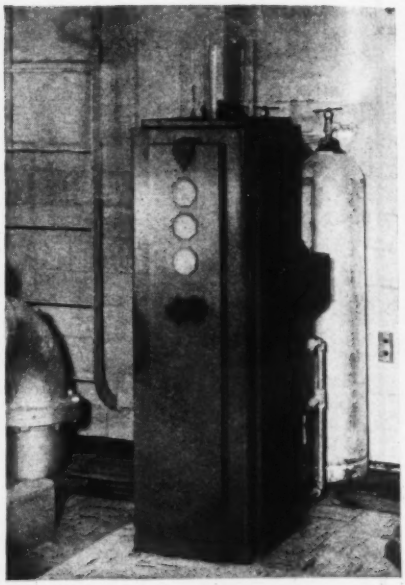
Here's the "Caterpillar" Diesel DW-10 Tractor pulling "Caterpillar"-built W-10 Wagon, with capacity of 11 cu. yds., heaped measure.

This "Caterpillar" Diesel DW-10 Tractor is pulling a LeTourneau Carryall scraper.

The new "Caterpillar" Diesel DW-10 Tractor with LaPlant-Choate scraper moving earth on an airport job.

SAFE WATER FOR WORKERS

WITH W&T ON THE JOB



Today, PRIVATE Water Supplies Carry a PUBLIC Responsibility That's Greater Than Ever

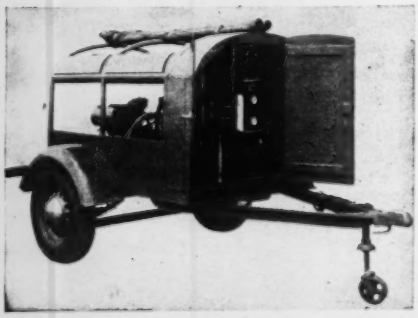
War-time conditions add new urgency to the universal need for well protected water supplies. Along with the higher standards of safety already being applied to public water supplies, there's an equal need for action to assure industrial workers full-scale health protection while on the job.

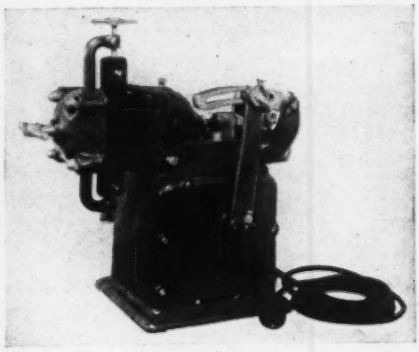
This means that water supplies for every industrial plant or construction project must be continuously safeguarded by closely controlled chlorination, just as are the supplies for America's military camps and establishments.

Moreover, when modern chlorination methods are applied, protection from water-borne disease is not the only gain. Often, taste, odor and color characteristics of the water may be improved. Frequently, too, the elimination of slime and other microbiological growths from pipes and processing operations pays for the cost of treatment.

More than 85% of the drinking water supplied in the United States is now protected by Wallace & Tiernan chlorinating equipment. W&T Representatives throughout the country are well prepared to help establish a water treatment system ideally suited to characteristics of your water supply for greater public safety and productive efficiency. Write today for technical bulletins.

SA-126





(Above) — For small water supplies, temporary and stand-by sources, this W&T Hypochlorinator combines high dependability with closely controlled feed. Inexpensive, too.

(Left)—The W&T Emergency Chlorination Trailer is self-powered for service "on location". Provides solution feed of chlorine over a wide range of application rates up to 300 lb. chlorine per day.

WRITE TODAY FOR THESE AIDS TO EXTRA SECURITY

W&T Technical Publication 228 describes the new W&T Emergency Chlorination Trailer in detail . . . gives specifications.

W&T Technical Publication, 225 gives a 7-point plan for building a sound defense for your water supply system, including data on emergency chlorination.

As in past emergencies W&T is putting forth every effort to meet the demands of the situation with standard Visible Vacuum Chlorinators or special equipment for any water treatment need. Valuable assistance on your specific problems is available without obligation. Just call your local W&T Representative or write direct to:

"The Only Safe Water is a Sterilized Water"

WALLACE & TIERNAN CO., INC.

MANUFACTURERS OF CHLORINE AND AMMONIA CONTROL APPARATUS
NEWARK, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

MEN AND JOBS

C. U. Smith, general manager and chief engineer of the Milwaukee harbor commission since 1931, has resigned his post. **Henry C. Brockel,** secretary of the harbor commission, was chosen to serve in the dual position of secretary and acting general manager.

Seth M. Van Loan, chief of the Philadelphia Water Bureau, has taken over a new post as engineer in charge of the Philadelphia $18,000,000 water system improvement program. He is succeeded in the water bureau post by **Martin J. McLaughlin,** formerly engineer in charge of construction at the municipal airport and director of public works under the late Mayor S. Davis Wilson.

Maj. Lyle Rosenberg, operations officer for the United States Engineer Office at Los Angeles, has been transferred to Caddoa, Colo., where he will assume the duties of district engineer.

Col. A. O. Van Suetendael, commander of the 368th Regiment of Engineers, U. S. Army Reserve Unit, has formed a firm under the name of A. O. Van Suetendael & Co. with offices at 20 So. Broadway, Yonkers, N. Y., and will deal in securities. Col. Van Suetendael was recently elected a member of the New York Stock Exchange. The new firm is believed to be the only member of the Stock Exchange to establish its headquarters in Westchester County.

N. S. Bateman, who was recently with F. R. Harris, Inc., and was superintendent for the Corbetta Construction Co. on the concrete work at the Bronx-Whitestone Bridge, is now chief designing engineer in the New York office of Leonard Construction Co., in charge of planning for construction. The firm holds several government contracts in connection with oil handling and storage and general construction.

Roland Lemieux has recently become city engineer and secretary-treasurer of the city of Sillery, just outside of Quebec. Mr. Lemieux was formerly an assistant to the district engineer, District No. 1, with the Department of Roads for the Province of Quebec.

J. G. Welsh has been appointed design engineer for the Bouchard Works of the Defence Industries, Ltd., Ste. Therese, Que. He has been acting as assistant to the resident engineer at the Bouchard works.

John R. Austin, who set new world records during the driving of the Carlton

SKILSAW'S SAWING SPEED saves minutes and men for QUICKER VICTORY!

YOU need fast-cutting SKILSAW for all sawing because Time, itself, is a weapon now . . . and SKILSAW saves the minutes on every operation that mean priceless hours saved on every job.

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Test SKILSAW on your own work TODAY! See for yourself how many sawing jobs it does . . . faster, better and *at lowest costs* . . . on wood, metal, stone, concrete and compositions. Your distributor will gladly demonstrate SKILSAW. Phone him NOW!

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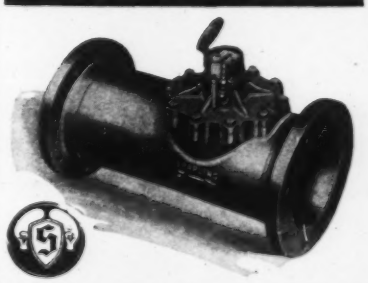
★ FOR THE DEFENSE OF AMERICA ★

SKILSAW DRILLS
For all drilling, boring and reaming in construction
Powered for deep wood boring in timbers . . . in roof truss construction, bridge building and erection of dams, superstructures and a hundred other jobs. Stronger, more durable, more powerful throughout.
23 MODELS

SPARLING MAIN-LINE METERS



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Every Sparling Meter is a complete totalizing unit, as easily installed as a valve or fitting, and enables you to keep consistently accurate records. Flow-rate indication and recording equipment optional.

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From every angle—original investment, power cost, maintenance, portability versatility and performance—this MALL 3 H.P. Concrete Vibrator is your best bet for 1942. It can be wheeled anywhere on the job by one man. It will place more yardage better and faster than can be accomplished by any other method. It can be converted as easily as changing bits in a brace for Concrete Surfacing, Wire Brushing, Sanding, Drilling, Sawing with Chain or Circular Saw, Grinding, Pumping and Sharpening Tools due to the interchangeable attachment feature. It will start easily in cold weather, runs by itself and operates on 1¼ to 2 gallons of gasoline per day. The variable speed, V-belt drive, gasoline engine provides ample power for each application. With hands getting scarce and schedules faster, you'll need this multiple-duty tool more than ever in 1942. Write TODAY for Complete catalog and ask for a FREE Demonstration.

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Now's the time to plan for tomorrow

Now is your golden opportunity to look around and investigate the service being rendered by

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We will be glad to furnish full details on the entire Smith line for your post war problems; or, if you are now in need of materials for maintenance and repair, you can secure priority from the O.P.M. which will enable us to make reasonable deliveries in view of the present abnormal conditions.

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drainage tunnel at Cripple Creek, Colo., during 1939-1941, is in charge of driving a section of the Continental Divide tunnel at Grand Lake, Colo. for Siers Bros., of St. Louis, Mo., the contractor.

L. P. Cousineau has recently joined the staff of the Dufresne Engineering Co., Ltd., of Montreal, after acting as assistant resident engineer for the past two years on the construction of a power development at Rapid No. 7, near Cadillac, Que.

F. A. Taylor has assumed the post as city engineer of Fulton, N. Y., succeeding **Harry Andrews** whose term of office expired Jan. 1. **Rex Carvey** has been named commissioner of public works. Mayor Elon K. Rowlee made both appointments after he took office on Jan. 1.

J. A. Rowat, engineer for Monroe County, Iowa, for the past five years, began his new duties as Emmet County (Iowa) engineer Jan. 3. His successor in Monroe county has not yet been chosen.

Alex Van Praag, Jr., of the engineering firm of Warren & Van Praag, Inc., Decatur, Ill., is now serving as senior business analyst in the government requirements branch of OPM at Washington, D. C.

Col. Harry W. Hill, second in command to **Col. Clinton W. Ball,** Rock Island, Ill., district engineer, will retire from the U. S. Engineer Corps in January.

Lloyd A. Sanderson, draftsman with the South Dakota State Highway Commission since April, 1941, has resigned to accept a position with the Boeing Aircraft Co. at Seattle, Wash.

Foster P. King, Tifton, Ga., resigned as of Nov. 1 as assistant division engineer at the Tifton division of the Georgia State Highway Department and has accepted a position as project development engineer with the Public Works Reserve.

T. M. Haverton, senior construction engineer of Region 3 of the Defense Public Works Division of the FWA, has been transferred from his headquarters at Richmond, Va., to Wilmington, N. C., to supervise the construction of defense public works there.

Robert Hill, of Huron, S. D., a recent graduate of the South Dakota State School of Mines at Rapid City, has accepted a position as research assistant at the Illinois Institute of Technology at Chicago. Other midyear graduates of the School of Mines who have accepted positions include: **H. Leroy Boberg,** of Parker, and **John Colgan,** of Hermosa, electrical engineers, who have obtained

There'll NEVER Be a Shortage
in the demand for dependability

CUMMINS DIESELS

Today—a contractor may face a shortage in men, material or equipment . . . but never in the need for proved power . . . assured dependability.

This doesn't mean power "proved" and dependability "assured" on the test block . . . the soft snaps . . . the 40-hour week. This means power *proved* and dependability *assured* by a 9-year record on the tough jobs . . . in the muck and mire . . . on the gruelling grades and under the engine-killing loads . . . in any weather and at all altitudes. This means full-rated *power at the wheel* 24 hours a day and 7 days a week . . . faster work cycles . . . uninterrupted operations. *This means Cummins Diesel power.*

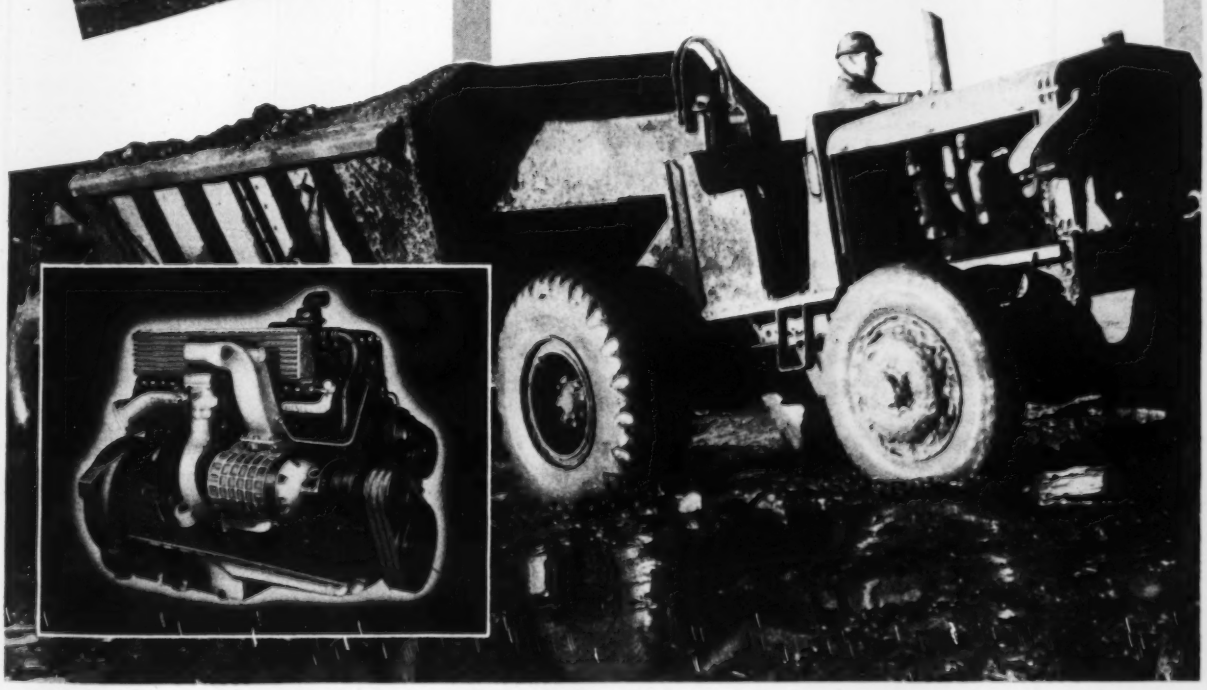
Yesterday, a delay on the job hurt only you. Today, a delay on the job hurts America. Make every minute and every hour count by specifying Cummins Dependable Diesels for your heavy-duty equipment. Cummins Engine Company, Columbus, Indiana.

Left, above, Frank W. Albert, Bigler, Pa., operates a pair of 2½-yard Lima 1201 Shovels, each powered with a Cummins Diesel.

Left, four Super C Tournapulls of 12-yard capacity, all powered with Cummins Diesels, are working on the Savage River Dam at Luke, Maryland.

At bottom, Model HBS-600 (Supercharged) Cummins Dependable Diesel, 200 hp. at 1800 rpm.

Below, one of six 14-yd. bottom dump Euclids, all powered with Cummins Diesels, which T. E. Connolly, Inc., San Francisco, is using on the Cottage Grove Flood Control Dam.



Riggers applying Genuine CROSBY CLIPS to a 1¼ inch messenger line preparatory to stringing the 3-inch "main gut" which is still coiled on the unopened reel shown in the picture. The cableway that was about to be strung when this picture was made has a span of 2,670 feet.

"You know CROSBY CLIPS will hold SAFELY....

.... BECAUSE THEY'VE BEEN DOING IT FOR 58 YEARS."

Yes, experienced riggers agree that there is one wire rope fastening you can bank on, and that is the

Genuine **CROSBY CLIP**

It is only logical to use steel clips to fasten modern steel ropes; the base of the Genuine CROSBY CLIP is a solid steel forging. The design has been worked out so that most metal is put where the greatest stresses fall. Over-size U-bolt and nuts; perfect finish all over. Heavily armored with zinc by the hot dip process.

Why run any risk? Standardize on Genuine CROSBY CLIPS.

Dealers with full stocks in all principal cities.

AMERICAN HOIST & DERRICK CO.

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positions with General Electric Co. at Schenectady, N. Y. as test engineers; **Erle Hubbard,** of Watertown, a metallurgical engineer, who has obtained a position in Baltimore, Md.; **Donald Kimball,** of Platte, with the American Smelting & Refining Co. at Selby, Calif., and **Burnell Slattery,** of Rapid City, who will join the United States Army Air Corps.

John H. Barr, for the past 16 years assistant engineer to the Oakland County (Mich.) Road Commission, has been appointed county road engineer of Livingston County, Mich.

Martin J. Cramer, senior engineer for the Public Roads Administration in Louisiana, has been named chief engineer for PRA in the district composed of Arkansas, Louisiana, Texas and Oklahoma. The appointment became effective on Jan. 5, 1942.

Alber Park, formerly area engineer for the WPA operations office at Casper, Wyo., has accepted a position as planning engineer for the Public Work Reserve for the state of Wyoming. The area operations office at Casper has been closed.

R. E. Overman, of Little Rock, Ark., has resigned as chairman of the Arkansas Flood Control Commission, to accept a position in the operations department of the U. S. Engineer Office at Little Rock. **John P. Morrow** of Batesville, Ark., has succeeded Mr. Overman as chairman of the commission.

James R. Lucas, of Sioux Falls, S. D., has accepted a position as architectural draftsman with the U. S. Army Engineers and will be assigned to the office at Galveston, Tex.

Jess Gentry, of Nathan's Creek, N. C., has assumed the title of acting supervisor of state highway maintenance in Ashe County, with headquarters at West Jefferson, N. C., following the death of George Doggett, former supervisor. Mr. Gentry was Mr. Doggett's assistant.

Adrian Hughes, head of the research department of the Baltimore Transit Co., Baltimore, Md., is serving as director of planning for the Baltimore Committee of Civilian Defense.

J. Trueman Thompson, professor of civil engineering at Johns Hopkins University, Baltimore, Md., has been appointed a member of the Commission for the Revision of the Maryland Motor Vehicle Laws.

C. B. McNairy is project manager for the T. A. Loving Co. and Associates on

(*Continued on p.* 167)

13 may be a Jinx on Friday—but it's TOPS in DRAWING PENCILS!

SMOOTH . . . yes, indeed! Combination of precious wax and quality graphite makes WINNER Techno-TONE fairly *glide* over paper. WINNER Techno-TONE gives you *all four* freedoms you demand in a drawing pencil . . . Freedom from Scratching, Flaking, Smudging and Gritty hard spots. Order WINNER from your dealer today.

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translates GRAY MATTER *into* BLACK MATTER
Made in U.S.A. Polished rich green. Packed in metal box.

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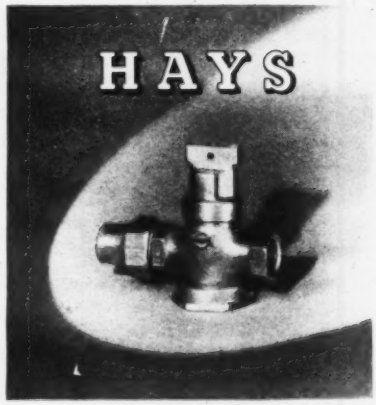

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TIMKEN BITS

will increase your production, speed up Victory, and later on, help you meet the competitive conditions of a post-war world.

A keen appreciation of *time* is the big reason why you contractors were quick to adopt Timken Bits soon after they were introduced 10 years ago. With the United States definitely in the war, time on projects vital to victory is more important than ever. Many of these projects involve rock removal. Therefore, the ability of Timken Bits to drill far faster becomes likewise more important than ever.

But look ahead to post-war conditions. Then one eye will have to be watching the calendar as always, and the other cocked to competition and costs. Hundreds of contractors have testified that the Timken Bit cuts drilling costs to the bone.

Adopt Timken Bits now. The advantage is a double-barrelled one. Write for particulars.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

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ROCK BITS

FLIES at Candler Field, Atlant… six Tournapulls took ov… earthmoving. Here's a Mod… C Tournapull high-balling 11 heaped ya… to the fill at 14 m.p.h. 4 LeTourneau 13-ya… Carryalls and 2 'Dozers are handling t… shorter hauls on this 1,380,000-yard d… fense project for C. M. Lyle Const.Co.

NOW

MORE THAN EVER

FOR MORE YARDAGE AND LOWER COSTS

ON LONG HAULS YOU NEED TOURNAPULLS

Tournapulls extend tractor - scraper economies to your longer hauls. Like big-capacity LeTourneau Carryalls, they are quickly pusher loaded. They haul at fast construction speeds (up to 14.3 m.p.h.) and spread their own loads, thus eliminate shovels and elevating graders for loading and 'dozers for spreading out the fill.

More Traction — High Average Speeds

Tournapull weight (plus 40% of the Carryall *and its load*) is centered on the drive wheels to give you the greatest possible tractive power. That means plenty of surplus rimpull for quick acceleration to top speed or for pulling through tough spots. Result—*high average speeds* and more *big* loads hourly.

Easy, Simple Operation

Just as tiller wheels have been discarded on track-type tractors, so LeTourneau has eliminated front steering wheels on Tournapulls. You pull and steer with the same wheels, just as you do with tracks on a track-type tractor. There are no front wheels to bog down when traveling or turning in mud or sand. Two-wheel design enables you to turn faster and sharper. Big brakes on both Tournapull and Carryall assure quick stopping and complete control on grades. Same fast, sure-acting LeTourneau cable control that has proved so popular on tractors, makes Tournapull-Carryall operation easy, too.

400 Model C's in Use

Today more than 400 Model C and Super C Tournapulls are in use, cutting costs on long hauls for hard headed, profit-minded earthmovers in 37 states and several foreign countries. Tournapulls can do the same for you — see your LeTourneau-"Caterpillar" distributor for complete details NOW

Loading common earth on the level with a "Caterpillar" D8 pusher and hauling over good roadways, you can expect the following yardages in a 60-minute hour from Tournapulls:

THESE PROFIT-MAKING YARDAGES CAN BE YOURS WITH TOURNAPULLS

Haul-One Way	98 H.P. Model C (11 yards heaped)		150 H.P. Super C (15 yards heaped)	
	Trips	Pay Yards	Trips	Pay Yards
600	17.1	150	15.0	180
1200	14.0	119	12.0	144
1600	12.3	104	10.7	129
2000	10.9	93	9.7	116
3000	8.4	71	7.6	91
5000	5.8	50	5.4	65

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PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

For Lowest Net Cost per Yard-CARRYALL* SCRAPERS, ANGLEDOZERS*, POWER CONTROL UNITS, BULLDOZERS, ROOTERS*, TRACTOR CRANES, PUSHDOZERS, TOURNAPULLS*, SHEEP'S FOOT ROLLERS, TOURNATRAILERS*, TOURNACRANE.

*Name Reg. U. S. Pat. Off

(*Continued from p.* 164)

the construction of roads through Cunningham Field, new marine airbase near New Bern, N. C.

H. A. Gibeau, formerly assistant director of the Montreal Public Works Department, has been appointed director to succeed his former chief, the late J. Emile Blanchard.

W. G. Bester, of Osceola, Iowa, formerly Clarke County engineer, has been appointed Union County engineer.

M. E. Bunger, engineer in charge of secondary investigations in Arizona for the U. S. Bureau of Reclamation, has been assigned as engineer in charge of the Blue River-South Platte power, irrigation and municipal water project in Colorado.

The American Institute of Steel Construction has announced the appointment of five men to act as the jury to select the prize-winning designs in the annual Students' Bridge Design Competition. Designs judged to be the first, second and third best will be awarded prizes of $200, $100 and $50, respectively. Prize winners will receive in addition certificates signed by the Jury of Award and by the officers of the Institute. The jury will meet at 101 Park Ave., New York City, on Feb. 18, 1942, to make its selection. It will include: **Lorimer Rich** and **Don E. Hatch,** architects; **Henry C. Tammen,** of Howard, Needles, Tammen & Bergendoff, consulting engineers; **Roger W. Sherman,** managing editor of *Architectural Record*, all of New York City; and **L. G. Sumner,** engineer of bridges and structures for the Connecticut State Highway Department, Hartford, Conn.

Lt. Col. L. B. Gallagher, district engineer of the Boston District, recently took command of the activities of the First Zone Construction Division, Office of the Quartermaster General, at Boston.

Louis A. Simon, supervising architect for the Public Buildings Administration of the Federal Works Agency, has retired from government service after 45 years. Mr. Simon entered the office of the supervising architect, which was then a part of the United States Treasury, in 1896. In 1905 he was made chief of the architectural division and his appointment as supervising architect became effective in 1934. Designs for more than a billion dollars' worth of federal construction passed through Mr. Simon's hands during his long career. The list of buildings includes the Triangle Building and many others in Washington as well as post offices, courthouses, customhouses, federal housing projects, federal hospitals and defense housing projects throughout the country. He is also credited with the design of the Roosevelt Library at Hyde Park, N. Y. In fact, President Roosevelt's high regard for Mr. Simon is believed responsible for five executive orders extending the length of the supervising architect's term of office beyond the normal retirement age. Mr. Simon is the holder of the gold medal of the Association of Federal Architects, an award made to him in 1935, and is also a Fellow of the American Institute of Architects.

Lt. Col. S. W. McIlwain, Zone Constructing Quartermaster, First Zone, has been assigned as assistant to the division engineer, North Atlantic Division at Boston, Mass.

Henry E. Roberts, of Rochester, N. Y., is now field engineer for the H. K. Ferguson Co. stationed at Noblesville, Ind. Mr. Roberts has been field engineer for the Monroe County, N. Y., division of regional planning; chief of party for the Genesee State Park Commission and an engineer for the E. I. du Pont de Nemours & Co.

Delos H. Smith, architect, of Washington, D. C., has suspended his practice to enter the Civil Engineer Corps of the U. S. Naval Reserve.

Vernon Miller, of Indianola, Iowa, has been selected by the Humboldt County board as county engineer, succeeding **Kenneth J. Smith,** who resigned Jan. 1.

Richard F. Snyder has been reappointed as superintendent of the sewage disposal plant at Massillon, Ohio.

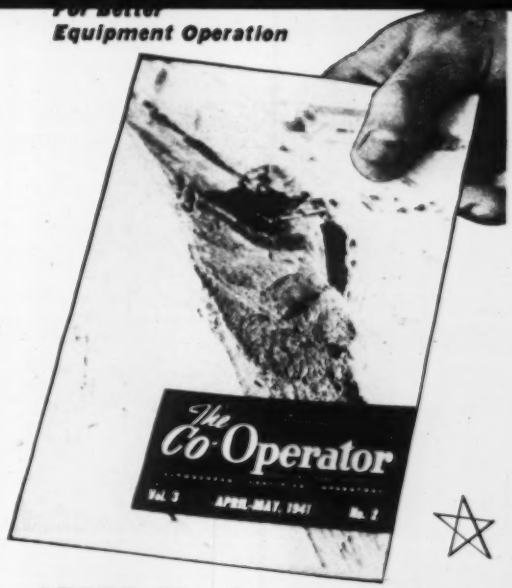
T. H. Carver, assistant engineer in charge of water supply for the city of Seattle, Wash., has retired after more than 36 years of service with the city. Mr. Carver designed all the city distribution systems of the water department and also its works at the Cedar River watershed, including the Lake Youngs storage reservoir.

E. A. Collier, state highway department division engineer at Portland, Ore., has been promoted to chief maintenance engineer, to succeed the late Jasper N. Bishop. **W. C. Williams,** division engineer for the department at La Grande, Ore., will succeed Mr. Collier in Portland.

Cecil A. Colpitts, roadmaster at Saskatoon, Saskatchewan, has been named division engineer for Saskatchewan for the Canadian National Railways.

Don S. Teter has become assistant superintendent of street construction and repairs for the city of Milwaukee.

For Better Equipment Operation



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Sixteen pages crammed with helpful money-saving information on:
LeTourneau equipment operation ● Equipment repair and maintenance ● Correct lubrication ● Care and operation of cable ● Care of tires ● Job layout

Written for and by the man on the job. Issued every other month. Read by more than 17,000 operators, mechanics, foremen, superintendents, engineers, etc. Let "The Co-Operator" help you train new men and give your veterans new ideas to increase their effectiveness. Just fill in the coupon below, telling us how many copies you can use.

REPLACE WORN CABLES WITH TOURNAROPE

Tournarope, a 6 x 19 filler wire, right lay, lang lay preformed wire rope with an independent wire rope center and an identifying galvanized core strand, is manufactured by LeTourneau especially for cable-operated tractor-drawn equipment.

For the past year all LeTourneau equipment shipped from the factory has been equipped with this new, specially made wire rope. As a result, Tournarope has been thoroughly tested by hard usage and is now used as standard on the country's biggest and toughest earthmoving jobs.

Made in Five Sizes

Tournarope comes in the following sizes: 3/8", 1/2", 5/8", 3/4" and 7/8". It is easy to order—all you have to do is specify the size and number of feet wanted. No worrying about type or lay. Order from your LeTourneau-"Caterpillar" distributor.

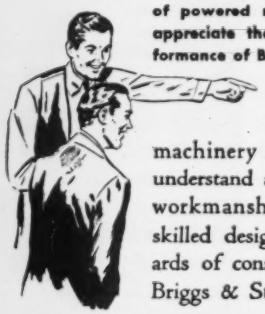
WRITE TODAY

R. G. LeTOURNEAU, INC.
Dept. ENR, Peoria, Illinois.
Please send me _____ copies of "The Co-Operator" each time it is issued.
Also send me:
☐ Tournapull Catalog TP-104
☐ Tournapull Application Folder TR-102
☐ How to Select a Self-Propelled High-Speed Scraper Hauling Unit
☐ LeTourneau Methods
Name _____
Position _____
Company _____
Address _____

4 CYCLE
BRIGGS & STRATTON
GASOLINE MOTORS

Production MANAGERS

Those men who supervise the manufacture of powered machines and appliances, appreciate the construction and performance of Briggs & Stratton Motors.



Production managers —men who know good machinery and how to make it— understand and appreciate the fine workmanship, quality materials, skilled designing and high standards of construction so evident in Briggs & Stratton motors.

They know how well it pays their companies to power with Briggs & Stratton motors and add their stamp of approval to these compact, dependable, air-cooled gasoline motors that make their equipment perform best — always.

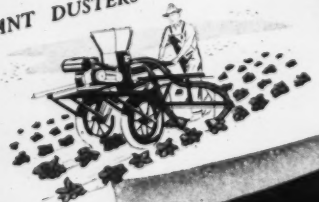
BRIGGS & STRATTON CORP.
Milwaukee, Wisconsin, U. S. A.

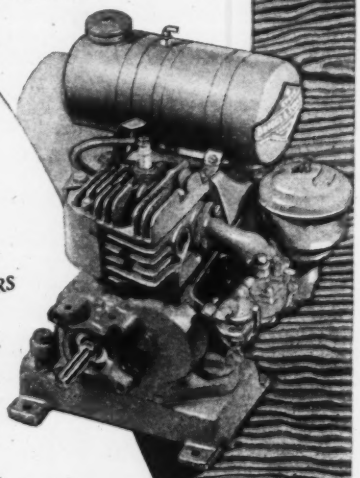
A Few of Numerous Briggs & Stratton Motor Applications

FLOOR SANDERS

PAINT SPRAYERS

PLANT DUSTERS





Col. Hoel S. Bishop, Jr. has taken command of the Providence District of the U. S. Army Engineers, a district that includes Rhode Island, a large part of Massachusetts and Connecticut. A West Point graduate, Col. Bishop served for four years in the U. S. Engineer Office at Philadelphia, was assistant engineer for the District of Columbia, and was recently commander of the 2nd Engineers Battalion at Fort Logan, Tex. He was also secretary of the Lower Mississippi Valley Commission and assistant to the president and division engineer of that commission.

R. O. Harris, formerly assistant division engineer for the Alabama State Highway Department at Tuscaloosa, has become associate engineer in the U. S. Engineer Office at Mobile, Ala. He was succeeded in the Alabama state highway department by **W. R. Palmore,** former materials engineer.

George A. Carter, Baltimore city highway engineer, has been appointed as full-time chairman of the executive committee of the Civilian Protective Defense for Baltimore. A veteran of 20 years in the municipal service in Baltimore, Mr. Carter is charged, among other duties on his new job, with the enrollment of fire watchers, auxiliary firemen, air raid wardens and rescue squads.

J. C. Carpenter, senior highway engineer for the United States Public Roads Administration, and a member of the district staff at Fort Worth, Tex., for the past 17 years, is now in charge of the Porto Rico office of PRA to supervise the building of a military highway system on the island.

James C. Rickards, Jr. has become water superintendent for the town of Canton, N. C., succeeding his father, the late J. C. Rickards, Sr., who was water superintendent for 30 years. Mr. Rickards was a graduate of North Carolina State College in 1936 and spent five years in chemical control work with the Champion Paper & Fibre Co.

Howard L. Mathews, formerly an engineer with the bridge department of the District of Columbia, is on active duty as a lieutenant commander with the Civil Engineer Corps of the U. S. Navy at the Washington Navy Yard.

C. U. Smith, who for the last sixteen years has served as general manager and chief engineer of the city of Milwaukee, tendered his resignation effective December 31, 1941, in order to enter consulting engineering practice. For the time being, he is located at Milwaukee, but anticipates moving to Los Angeles, Calif., in the very near future.

A line as black as night!

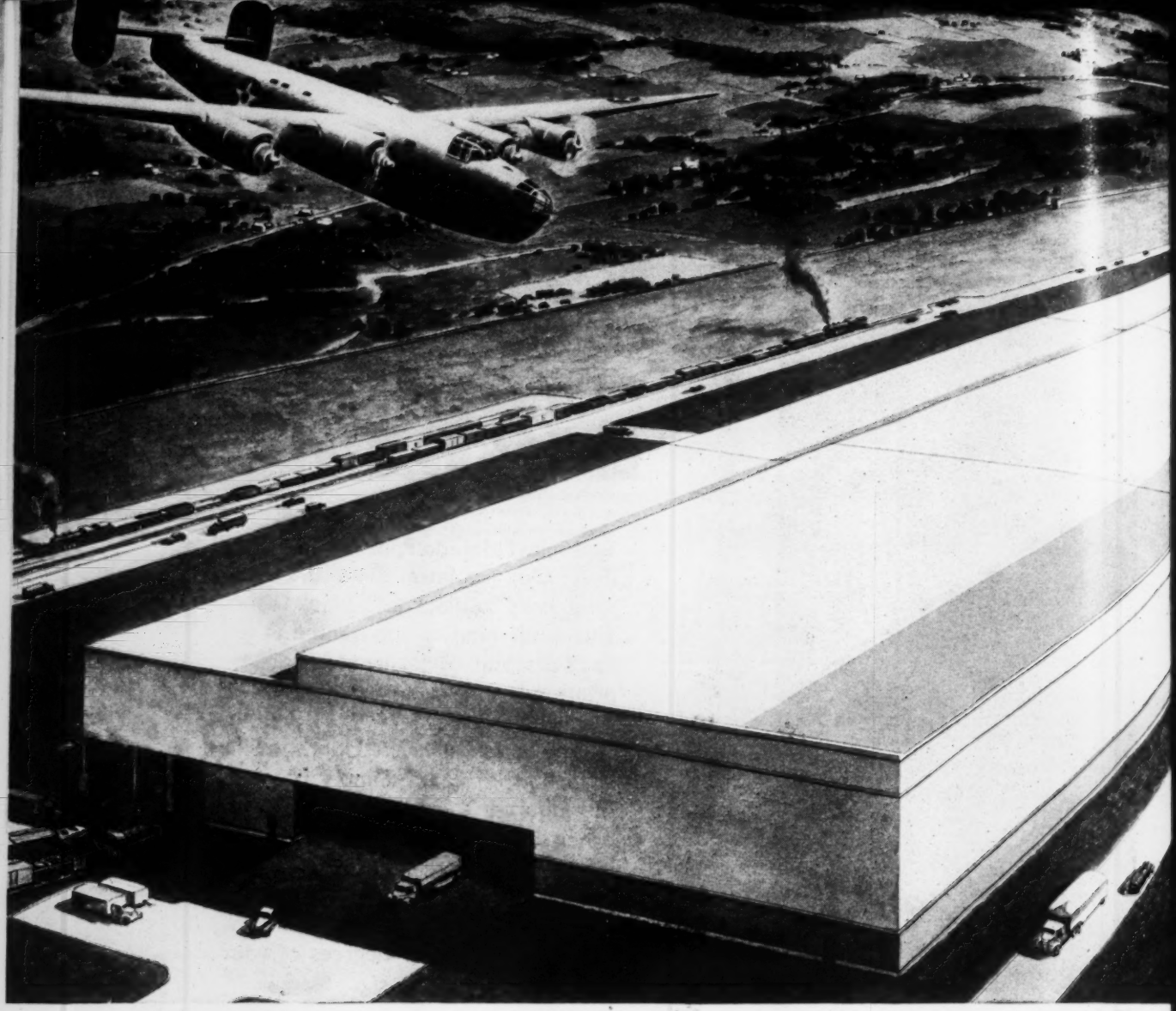
Typhonite Eldorado Pencils make such lines! Opaque lines! Lines firm and solid, lines as black as a black feline. This is the kind of line wanted in today's drawings—because today's blueprints must be clean as the path of a bullet.

Why is the *Typhonite* Eldorado line so opaquely black? Simply because the Eldorado's lead is *Typhonite*. No other drawing pencil has *Typhonite* leads. *Typhonite* is created out of natural graphite by an exclusive Dixon process. Try *Typhonite* Eldorado Pencils in any of the 17 degrees of your choice.

This interesting, informative booklet, a little history of pencil making, is yours for the asking. Please write on your business or professional stationery.

Pencil Sales Department 227-J1

JOSEPH DIXON CRUCIBLE CO. • JERSEY CITY, N. J.



Not "how big?"... but "how

...That's the big news about the Army's huge bomber plants which combine steel and Fiberglas* in a new-type construction and set new performance standards...

On January 1st, this year, two new bomber plants were nearly completed. One at Tulsa, Oklahoma. The other at Fort Worth, Texas.

They are two of the largest bomber plants in the world... housing two of the largest unobstructed floor areas ever built.

But the almost unbelievable hugeness of these two plants, each nearly a mile long, is only part of this unusual story.

For these bomber plants, specifications never before required were set up. Specifications drawn to quiet the shut-in noise for men busy with hundreds of riveters, rumbling cranes, stamping and drill presses. Specifications to muffle the din of metal on metal, *and* to provide the mammoth snugness of a controlled climate and uniform lighting. The problem *had* to be solved. But previously known types of construction could not meet the specifications. And yet they were met! With engineering imagination... and the use of two important basic materials of known performance—steel and Fiberglas.

The marriage of these two basic materials produces a *roof* construction and a *wall* construction, each of which combines noise reduction, light reflection, and thermal insulation *in one unit*. Simple as this may appear, this combination of steel and Fiberglas opens up a whole new field of building practice.

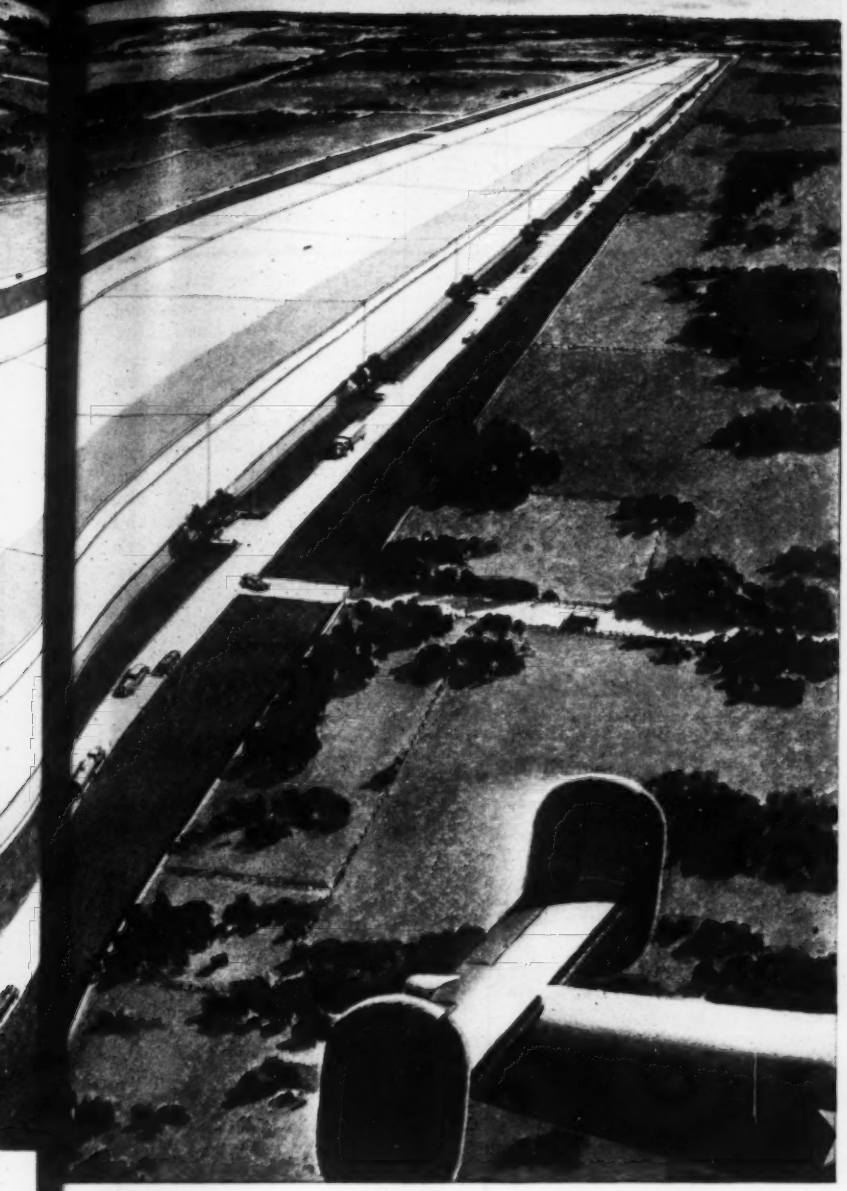
Besides reducing pent-up reverberations, this new-type construction provides side walls and roofs that are shatter-resistant, non-combustible, and enduring. In addition, it gives a highly efficient insulation that will keep heating expense in winter and cooling expense in summer at a minimum. Otherwise the cost of operating the air-conditioning systems in these huge plants would be out of sight.

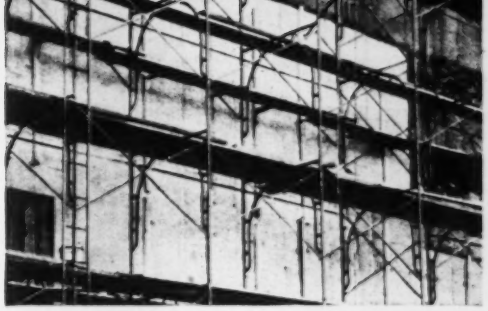
This construction gives the complete controlled conditions inside these plants... even temperature and humidity... high light-reflecting interior surfaces... to provide ideal working surroundings for high-speed production and precision manufacture.

Controlled conditions are also necessary to protect costly materials and sensitive instruments in storage and assembly.

Fiberglas and steel lick these tough requirements... they do *more!* They give the "plusses" of unusually light weight... ease of handling on the premises... and very long life.

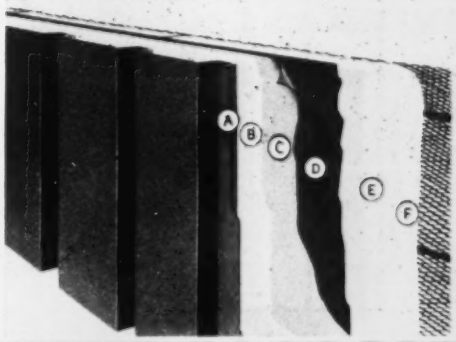
You're probably not interested in bomber plants 4/5ths of a mile long, but your defense contracts may call for smaller plant units... where complete or semi-

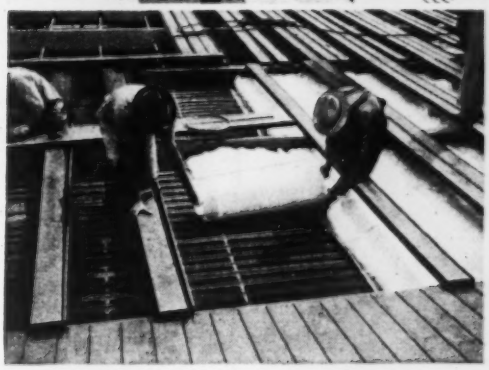




WALL OF STEEL AND FIBERGLAS designed and built by The Austin Company. View shows Truscon steel channel sections and interior Fiberglas insulation already in place in upper sections and at right. In center, semirigid Fiberglas insulating board in place!

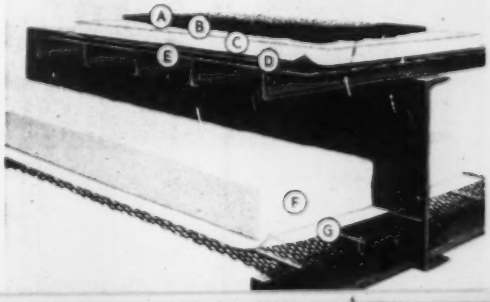
DETAIL OF WALL SECTION. "A"—Exterior steel facing. "B"—1-inch-thick semirigid Fiberglas for thermal insulation. "C"—Vapor barrier paper. "D"—Special sheet steel channel section. "E"—4-inch Fiberglas wool compressed to 3-inch thickness for thermal insulation and noise reduction. "F"—Thin, Fiberglas Retainer Mat provides light-reflecting, repaintable surface.





ROOF CONSTRUCTION. Above you see roof nearing completion. Workmen are unrolling Fiberglas blankets. These in turn are covered by Truscon Ferrobord Steeldeck, Fiberglas roof-deck insulation, and finally by waterproof roof material.

DETAIL OF ABOVE. "A"—Tar and gravel roof weathering surface. "B"—Heavy, lapped tar paper. "C"—13/16-inch-thick, semirigid Fiberglas roof deck insulation. "D"—Vapor barrier paper. "E"—Ferrobord Steeldeck. "F"—3-inch thickness of Fiberglas wool with dead air space above for thermal insulation and noise reduction. "G"—Thin, Fiberglas Retainer Mat for light reflection, held in place by metal lath. Provides a repaintable surface.



was it built?"...

controlled conditions will aid in making every man-hour count. Perhaps this new-type construction can give these plant units to you cheaper . . . quicker. For it requires a minimum of materials, using each at its maximum efficiency.

You may not be interested in plant construction at all, but the ability of Fiberglas to improve other products can still be helpful to you . . . if, for example, you are a maker of plastics, the high tensile strength and moisture resistance of Fiberglas indicate its value as a re-enforcing material.

And for the same reason—among others—Fiberglas and *rubber* . . . or Fiberglas and common textile fibers—can result in new and better ways of making many things.

We urge you to look into Fiberglas as a component of thermal, electrical, acoustical, and plastic products. Fiberglas itself is made from materials which are available in unlimited quantities right here in continental United States. Let us give you and your research staff the benefits of our basic experience with Fiberglas and its properties.

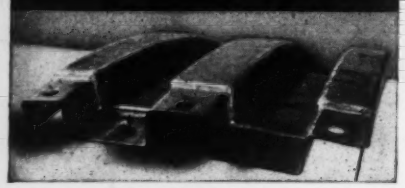
Remember: Fiberglas is *pure* glass in fiber form . . . springy . . . processed into blankets, thread, yarn, bonded sheets, semirigid boards. As a proved basic material it is now playing a vitally important part in the production, maintenance, and operation of planes, tanks, warships, and armored cars out on the firing line. For further information write: *Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

OWENS-CORNING

FIBERGLAS

*T. M. Reg. U.S. Pat. Off.

GAIN 65 TO 430% MORE LINER STRENGTH!



ARMCO Plates provide more strength with less weight. Design makes the difference.

GAGE	SECTION MODULUS		
	PER IN.	PER FOOT	PER SECT.
12	.1146	1.375	2.063
10	.1459	1.751	2.627
8	.1766	2.119	3.179
7	.1933	2.320	3.479

• Gage for gage you'll find ARMCO Heavy Duty Tunnel Liner 65% to 430% stronger (section modulus) than any other plate. Here's what this greater strength with less weight means in terms of easier, safer tunneling . . . .

On a strength/weight basis ARMCO Plates cost less at the start. You save on installation because the work moves fast. One man handles the light sections and only structural wrenches are needed for assembly. Where completed rings can be spaced to take advantage of partly self-supporting ground, you may actually buy fewer plates.

Let ARMCO Liner Plates help speed the work and cut costs. There is a wide range of sizes and gages for light or heavy duty service. Write for the whole story. ARMCO DRAINAGE PRODUCTS ASSN., 85 Curtis Street, Middletown, Ohio.

ARMCO

TUNNEL LINER PLATES

New Aids to the Constructor

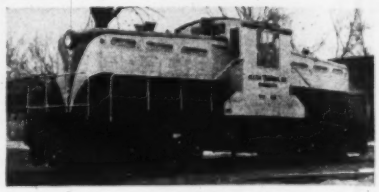
Equipment and material announcements and manufacturers' news

Mobiloader

A new Model 8 Mobiloader, which is sold by Caterpillar dealers, digs at the front and dumps overhead to the rear, employing the same principle as the W4 Mobiloader now used on a wide variety of loading operations. Bucket capacities range from 2.7 to 9.5 yd., depending upon the type of materials to be handled. The outfit is mounted on a Caterpillar D8 tractor and will load earth, sand, clay, gravel and many other materials.—*Athey Truss Wheel Co., 5631 W. 65th St., Chicago.*

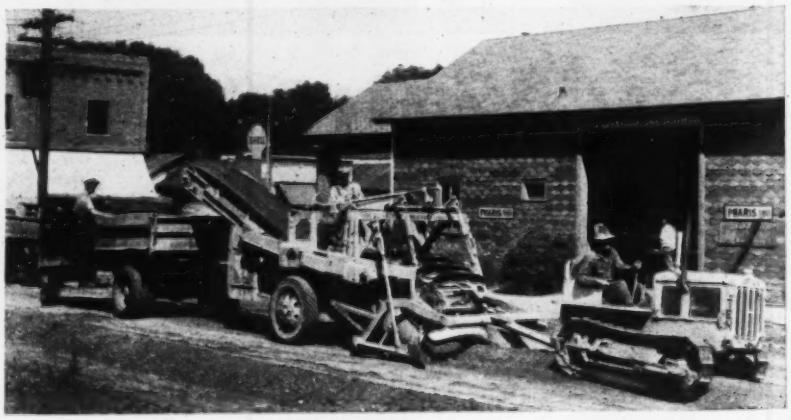
Expansion Material

A line of asphalt, fibre and cork expansion joint material designed to meet all requirements of monolithic concrete construction has been announced by Keystone. Each type is supplied to meet federal and state specifications and can be fabricated to meet specifications for any special job. The asphalt joint is composed of asphalt, fibre and mineral fillers, formed into sheets and reinforced with a layer of felt on both sides. It possesses a high degree of compressibility to permit perfect coordination of expansion with slab movement. The fibre joint consists of a fibre board impregnated with a waterproof asphalt to provide a non-extruding, resilient product that permits free action of the slab. The cork joint, made from new live cork particles with a resinous binder, is produced under heat and pressure to retain all inherent features of the natural cork.—*Keystone Asphalt Products Co., 43 E. Ohio St., Chicago.*



80-Ton Diesel

Whitcomb has added a new 80-ton unit to their line of internal combustion locomotives. It is powered with two Buda supercharged diesel engines, each developing 325 hp. which provides ample power to insure snappy performance in switching and spotting cars as well as road work at speeds up to 40 mph. The



Force-Feed Loader

A new force-feed loader, for use behind a motor grader, truck or tractor is announced by Athey. The loader is available also in a self-propelled unit. The machine scoops up windrows of earth, dirt, rocks or other materials from the road surface behind the blade of the motor grader and conveys the material over a belt into a truck which is loaded as it moves. Power is furnished by a 22 hp. gasoline engine mounted on the chassis. The purpose of the Athey force-feed loader is to clean up excess materials from road or street surfaces following maintenance or grading work.—*Athey Truss Wheel Co., Chicago.*

On the job—For America

This large Jaeger Concrete Spreader manufactured by the Jaeger Machine Company, Columbus, Ohio, speedily building runways on an important bombing field job.

Ferry and Pearson, Los Angeles contractors, are operating the equipment. A Continental Red Seal Power Unit PM271 is supplying the power.

On countless jobs throughout America, Continental Red Seal Engines are at work — supplying horsepower to save manpower.

Continental Motors Corporation

MUSKEGON, MICHIGAN

Sidney Harbor Bridge

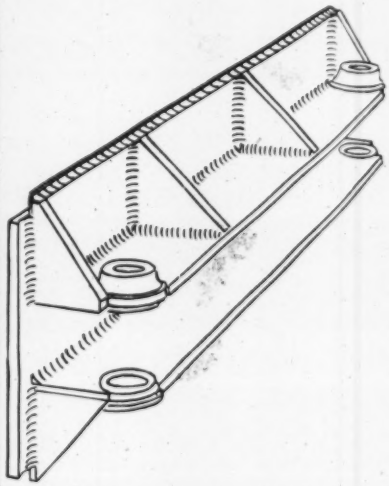
Reduce Costs
Conserve Materials
Insure Safety
with WHITTEMORE STRAIN GAGES

The cost of engineering structures can be decreased through a more efficient use of material and the elimination of members which do not carry their share of the load. Safety can be insured by determining whether or not computed stresses are in close agreement with actual stresses.

Whittemore hand strain gages are inexpensive—can be used by observers having little training. With these, stresses in each member of a complex structure can be determined at a reasonable cost. Whittemore strain gages—rugged, simple, and accurate—are available in 2-in. and 10-in. gage lengths. Write for Bulletin N-153 describing these and other Southwark strain gages.

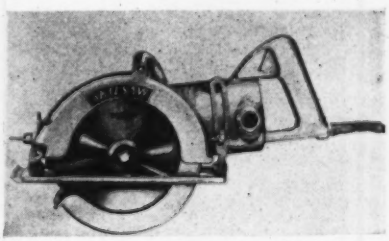
Baldwin Southwark
DIVISION OF THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA
BLW THE BALDWIN GROUP

normal tractive effort is 40,000 lb. at 25 percent adhesion and the locomotive is capable of exerting 53,330 lb. tractive force with the use of sand. Each engine-generator unit, including radiator, air compressor, and blower is mounted on a common sub-base mounted on the locomotive frame. An important advantage of the power plant arrangement is the accessibility of the generators for inspection. The complete sub-assembly can be easily removed through a hatch in top of the hood. The cab is well insulated and equipped with safety glass windows rubber mounted in steel sash with maximum vision in either direction provided for the operator.—*Whitcomb Locomotive Co., Rochelle, Ill.*



Push Dozers

Buckeye has announced the development of a new line of Unitilt push dozers and push dozer pads for use on Buckeye Unitilt bulldozer frames. These units are now being built in two sizes: 24″ x 61″ for Allis-Chalmers HD-14 and HD-10-W tractors, International WTD-18 and WTD-14 tractors, and Cletrac FD Series machines; 24″ x 57″ for Allis-Chalmers HD-10 and International TD-18 tractors. —*Buckeye Traction Ditcher Co., Findlay, Ohio.*



Portable Saw

The new 8¼ in. Skilsaw is a fast-cutting tool for all sawing in the framing of structures. It cuts to a depth of 2⅝ in. in wood for fast easy sawing on all 2 in. rough lumber, bevel-cuts lum-

when you require
WATER TIGHTNESS
STRENGTH
HIGH CARRYING CAPACITY
LONG LIFE
LOW MAINTENANCE
OVERALL ECONOMY
in a pipe line
remember LOCK JOINT

USERS SAY "NO MAINTENANCE"

Water works engineers report "Maintenance nothing"—"Line never shut down for repairs"—"No maintenance to date" on Lock Joint Reinforced Concrete Pressure Pipe Lines after eighteen, twenty, and twenty-six years of service. This is conclusive proof that maintenance is an absolute minimum. Here are the reasons: The conservative design of Lock Joint Pipe providing a high factor of safety against sudden surges and overloads—the flexibility of the watertight expansion joints—the inherent characteristic of concrete to completely and permanently resist corrosion and tuberculation—and the years of experience of Lock Joint Engineers, Superintendents and Foremen, not only in the design and manufacture of the pipe, but also in its installation on large water works projects—all these assure a job well done and of lasting quality.

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All the power you need!

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2. Repairs and parts available at Ford garages everywhere.
3. Lightweight, easy to handle. (May be towed at permissible truck speeds.)
4. Capacity easily varied for different jobs.
5. The ruggedness and efficiency of these famous compressors are a source of constant satisfaction to users.
6. Automatic unloading and idling; self-starter.
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8. Standard, quality parts.

★ SMITH COMPRESSORS are saving money for companies the country over. Consider the savings you'll enjoy with their use! BIG savings in purchase cost over standard compressors of equal capacity . . . important savings on upkeep, too! Made with FORD Motors and standard parts—that means dependability and economy.

With a Ford Motor and shop facilities you can assemble your own Smith Compressor. We will furnish a Smith Compressor Head and Accessories with complete instructions for mounting.

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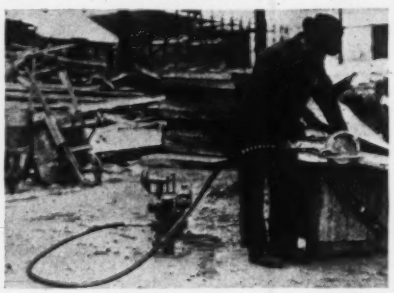
AIR COMPRESSORS

ber up to 2⅛ in. thick at 45 deg., has a free blade speed of 3000 rpm and is designed for use with abrasive disks to cut and score stone, concrete, etc. The new Skilsaw Model "825" is 18 in. long and weighs 18½ lb.—*Skilsaw, Inc., 5033–43 Elston Ave., Chicago.*



Power Unit

Mall has what they call a Jack-of-all-Trades power unit designed to be used with the proper attachments for concrete vibrating, concrete surfacing, sawing, sanding, wire brushing, grinding, drilling in all kinds of materials, and pumping. The outfit has a 1 hp. variable speed gasoline engine unit and is mounted on a full swiveling base. It is normally furnished with a ⅞ in. diameter by 12 ft. long flexible shaft and housing and can be supplied with all types of attachments to do almost any small construction job.—*Mall Tool Co., Chicago Ill.*

Welder

A single pre-set current adjustment with arc control is featured in the new portable d.c. Flexarc welder available in ratings of 200, 300 and 400 amperes with 220, 440 or 550 volt a.c. motors. J. H. Blankenbuehler, left, and D. L. Hadley, right, both of the Westinghouse East Pittsburgh works, engineered and designed the unit.—*Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.*

At Danger Points in Defense Work . . .

USE CATAPHOTE REFLECTOR BUTTONS

More and more of today's safety problems in industry and construction are solved with Cataphote Reflector Buttons! Widely used for State and National highway markers, these Reflectors provide brilliant illumination at danger points in Defense Camps and Defense Plants . . . also ideal for safer roads, streets, bridges and industrial plant traffic handling. Write for information.

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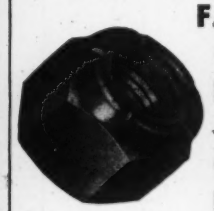
TOLEDO, OHIO

For **VIBRATION-PROOF FASTENINGS** *ON* **ROAD-BUILDING** *AND* **CONSTRUCTION EQUIPMENT**



Elastic Stop Self-locking Nuts put an end to maintenance troubles resulting from loose fastenings. They can not be loosened by vibration, shock loads, or exposure to weather. Available in all standard sizes.

SPECIFY THEM ON NEW EQUIPMENT AND USE THEM FOR REPLACEMENT

CATALOG contains a graphic explanation of the Elastic Stop principle, presents test and application data, and lists the complete line of nuts. • **Write for a copy.**

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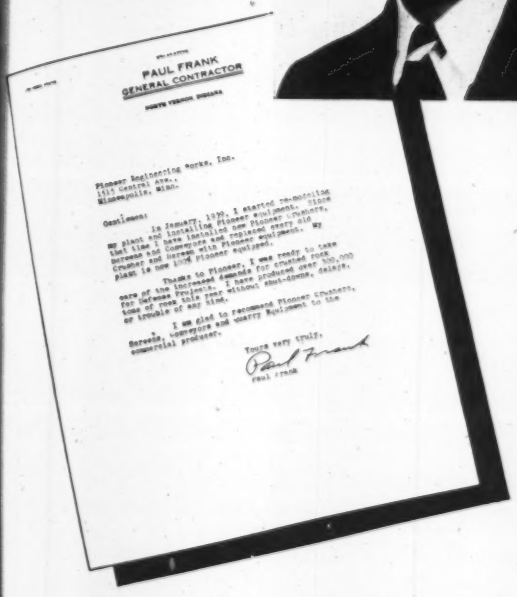
Elastic Stop SELF-LOCKING **NUTS**

PIONEER
Foto Facts
No. 14

WITH INCREASED DEMANDS FOR DEFENSE PROJECTS, PAUL FRANK REQUIRED MORE PRODUCTION AND BETTER CONTROL OF QUANTITIES OF EACH SIZE.

300,000 TONS CRUSHED ROCK IN ONE SEASON

Meet Mr. Paul Frank
General Contractor
North Vernon, Indiana



PAUL FRANK
GENERAL CONTRACTOR
NORTH VERNON, INDIANA

Pioneer Engineering Works, Inc.
1515 Central Ave.,
Minneapolis, Minn.

Gentlemen:

In January, 1930, I started re-modeling my plant and installing Pioneer equipment. Since that time I have installed new Pioneer Jaw Crushers, increased and improved my screening capacity, and my plant is now 100% Pioneer equipped.

Thanks to Pioneer, I was ready to take care of the increased demands for crushed rock for Defense Projects. I have produced over 300,000 tons of rock this year without shut-downs, delays, or trouble of any kind.

Herewith, I am glad to recommend Pioneer Crushers, Screens, Conveyors and Quarry Equipment to the commercial producer.

Yours very truly,
Paul Frank

Here's how Paul Frank, large commercial quarry operator at North Vernon, Indiana, again stepped up his output of crushed rock and agricultural limestone.

He installed a Pioneer 30"x42" Primary Jaw Crusher, 3 new Pioneer Vibrating Screens and another Pioneer 40"x22" Roll Crusher.

A 100% Pioneer equipped plant . . . and read what Paul Frank has to say about it.

PIONEER ENGINEERING WORKS
1515 CENTRAL AVENUE · MINNEAPOLIS, U. S. A.

Rex Speed Prime Pump on overpass job.

Stepping up and maintaining work schedules during these days of high pressure production in all lines, requires equipment of maximum dependability and efficiency.

Because Wisconsin Engines (1 to 35 hp.) are built for *heavy-duty service; because they are air-cooled; because they are* compact in design; extremely light in weight; equipped with weather-sealed outside magneto with impulse coupling for quick starting in any weather; because they run on Timken roller bearings... Wisconsin Engines AT WORK today, are increasing productive capacity wherever they are in use.

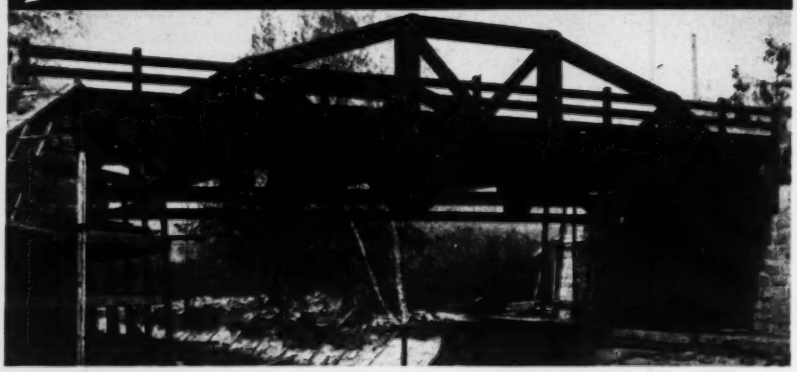
MOST POWER for POUND

WISCONSIN MOTOR Corporation

MILWAUKEE, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

For Economic PERMANENCE



Highway Structures of Douglas Fir

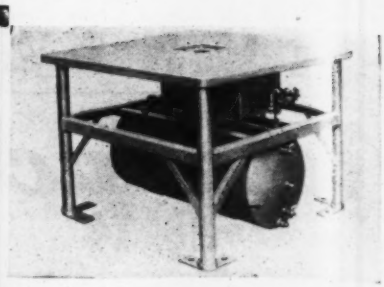
Designs and Illustrations of GUARD RAILS - CULVERTS - TRUSS BRIDGES - TRESTLES - ARCH BRIDGES - SUSPENSION BRIDGES - as built in Douglas Fir

THESE items are presented in a new booklet published by the West Coast Lumbermen's Association. A copy will be mailed free upon request. Write for this booklet today. Today's heavy travel demands good highways. Wood is available—bridges and other highway structures, strong and durable for anticipated years of service, may be built NOW—with speed and economy.

Yours on request —no charge

WEST COAST LUMBERMEN'S ASSOCIATION

364 Stuart Bldg., Seattle, Washington



Oil Forges

Hauck has a new oil burning forge for blacksmith and pipe shops to be used with compressed air at 40 lb. or more pressure. A furnace of loose firebrick can be built on top of the table and around the work to confine and increase the heat which is available up to 2800 deg. F. Heat can be started and stopped instantly and closely controlled. The firebox, which is removable, and the flame outlet are lined with high grade firebrick. It is easy to operate and can be furnished to burn any gaseous fuel.—*Hauck Manufacturing Co., 124–136 Tenth St., Brooklyn, N. Y.*

High Lift Truck Body

We know that most of our readers will never ice cars but this is a reminder of a type of equipment available which may have many construction possibilities.—*Gar Wood Industries, Inc., Hoist and Body Division, Detroit, Mich.*

Booster Engine for Truck

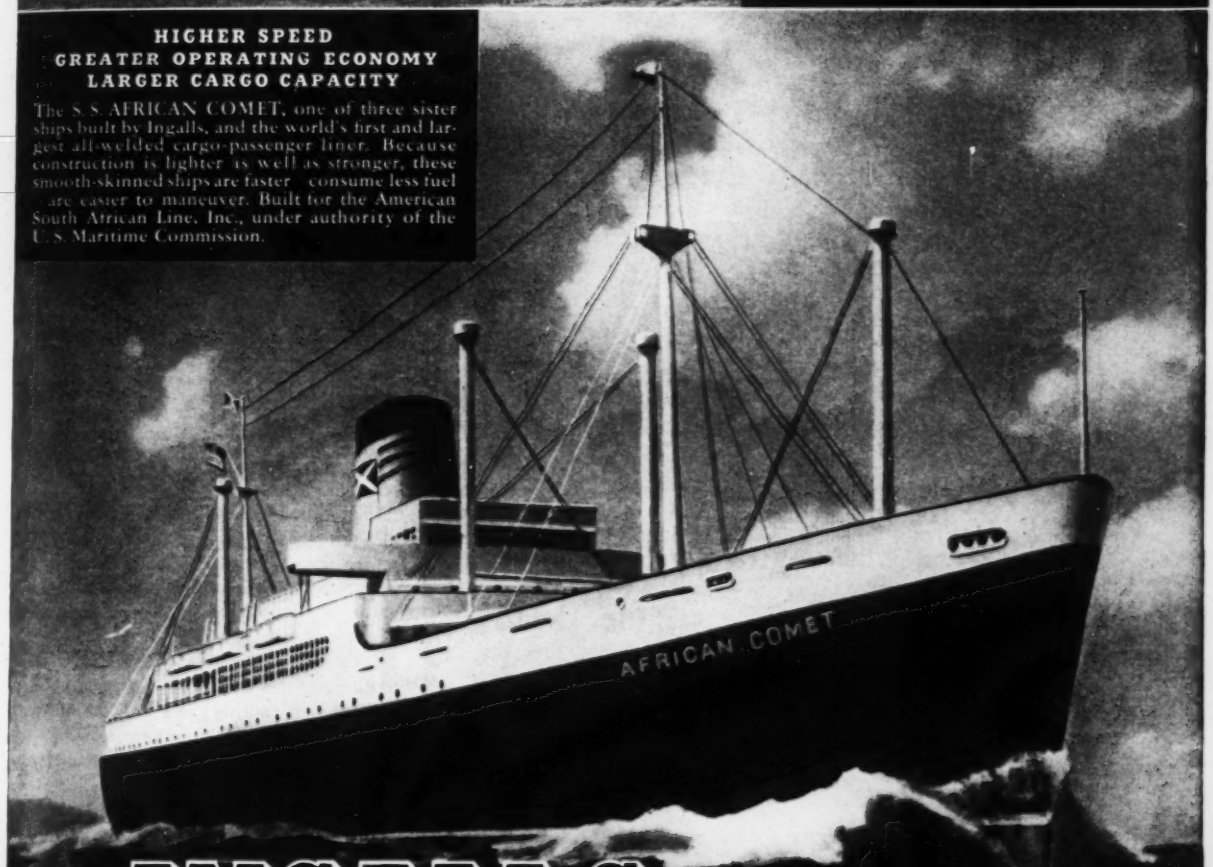
The use of a Clark booster engine, added to a standard truck, in a stiff 14-mile climb at Berthoud Pass, Colo., effected a 42 percent saving in time, a 72 percent gain in speed, and a 23 percent reduction in fuel consumption. The American Automobile Association contest board, which officially observed the test, certified that a Chevrolet tractor unit equipped with a Clark booster engine and towing a loaded trailer weighing 28,000 lb., established the following records in two climbs to the pass: with booster engine cut out—time, 1 hr. 40

LIGHTER, STRONGER CONSTRUCTION — FASTER ERECTION

AIRPLANE REPAIR SHOP, built by Ingalls, the nation's largest independent fabricator of structural steel. Long outstanding in the field of riveted construction, this company is maintaining its leadership by increased application of improved arc-welding methods. Beneficial results are obtained in Decreased Weight · Stronger Construction · Lower Steel Costs · Faster Erection · Greater Freedom of Design. Nation-wide engineering and erection service assures efficiency through all stages of operation.

HIGHER SPEED
GREATER OPERATING ECONOMY
LARGER CARGO CAPACITY

The S. S. AFRICAN COMET, one of three sister ships built by Ingalls, and the world's first and largest all-welded cargo-passenger liner. Because construction is lighter as well as stronger, these smooth-skinned ships are faster · consume less fuel · are easier to maneuver. Built for the American South African Line, Inc., under authority of the U. S. Maritime Commission.



THE INGALLS IRON WORKS COMPANY
BIRMINGHAM, ALABAMA

Subsidiary Companies and Divisions
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Here is the latest innovation in TRACING CLOTH containing all of the fine qualities which the most expert draftsman desires. Tested and proven in quality for surface efficiency. Cleans easily. Corrections of ink or pencil made easily, but the superiority of this NEW Tracing Cloth is best proven by use and you are urged to send for a large working sample sheet. We shall abide by your decision.

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NEW YORK, N. Y.

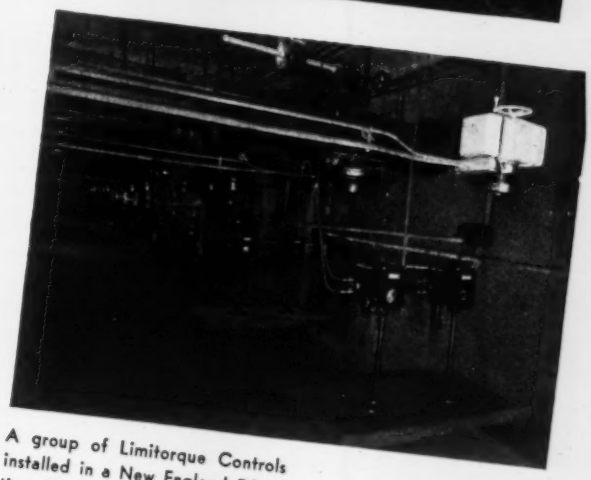
min. 5 sec.; average speed, 8.37 mph; gasoline consumption, 10.8 gal. With booster engine operating—time, 58 min. 30 sec.; average speed, 14.36 mph; gasoline consumption, 8 gallons. The Clark automatic booster engine is installed in a regular truck chassis in back of the cab and below the level of the body platform. It delivers its power through the truck transmission and regular drive shaft. As long as the truck engine can maintain a road speed of 31 mph or more in high gear, the booster engine does not start. When, however, the truck encounters a grade sufficient to cause it to slow down, with wide open throttle, to 31 mph, the booster engine automatically cuts in, adding its power to that of the main engine to maintain cruising speed. When the truck again reaches a speed of 45 mph, the booster engine automatically cuts out.—*Clark Equipment Co., Buchanan, Mich.*

Employee Identification

The Ident-O-Graph is a photographic development to aid the present-day requirements for positive identification of wartime construction and industry. The outfit is set up to give accurate height, a good portrait and number identification in one instantaneous photograph. The outfit has the necessary lights attached, is compact, sturdy and can be moved about at will as it weighs only 57 lb. Twenty-four exposures are provided on each film and cartridges can be inserted without losing time, it being claimed that up to 1,000 pictures can be made in an 8-hour day.—*Photographic Equipment Co., 210 E. Park Way, Pittsburgh, Pa.*

Fluorescent Light

A new Benjamin "RF" fluorescent lighting unit is said to provide even more light than previous units for the power consumed; to provide a new solution to



A group of Limitorque Controls installed in a New England Filtration Plant.

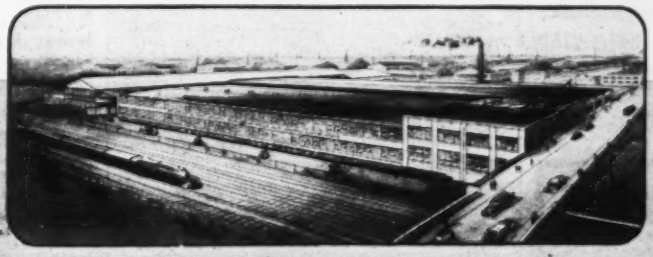
WHEREVER valves must be operated without fail and without delay, Limitorque Controls prove their dependability. They open or close sluice gates and valves of all types from 3" to 96" diameter . . . operated from conveniently located control stations or central master control panels. Whether for emergency service or normal operation, Limitorque assures an unfailing means of control by responsible workmen.

The choice of many water works and sewage disposal plants throughout the country, Limitorque's unfailing reliability demands your investigation . . . either for new constructions or the modernization of present plants. Limitorque can be readily adaptable to existing equipment. Write us for complete information.

PHILADELPHIA GEAR WORKS

**INDUSTRIAL GEARS
AND SPEED REDUCERS
LIMITORQUE VALVE CONTROLS**

**ERIE AVENUE & G STREET
PHILADELPHIA, PA.**
New York, Pittsburgh, Chicago

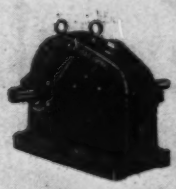


***Philadelphia*
LIMITORQUE
CONTROL**
operates all types of valves, etc., safely, economically, from convenient stations.

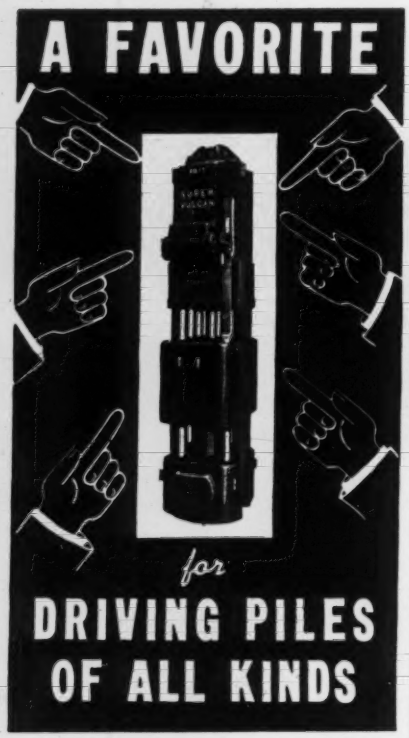
***Philadelphia*
GEARS**
All types and sizes of industrial gears. Can be supplied in all materials.

***Philadelphia*
WORM GEAR
SPEED REDUCER**
right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

***Philadelphia*
MOTOREDUCER**
The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.



***Philadelphia*
HERRINGBONE
SPEED REDUCER**
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.



SUPER-VULCAN OPEN-TYPE

DIFFERENTIAL-ACTING

PILE HAMMERS

18C, 30C, 50C, and 80C

More and more users are depending on VULCAN to get their pile driving requirements done more quickly and get a faster start on construction.

More and more repeat orders tell the story of satisfaction. Users find that they can drive piles faster, easier, and at less cost — get more dependable performance and longer service from their Super-Vulcan Open-Type Pile Hammers.

Rugged strength—simple design—positive action — durability — compactness are all important features.

The open type fits the same leads and uses the same accessories as the Vulcan Single-Acting Pile Hammer.

VULCAN IRON WORKS Since 1852

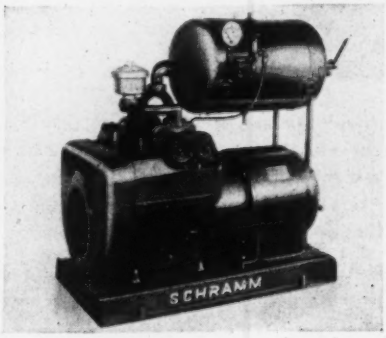
331 North Bell Avenue

Chicago Illinois

the flicker problem; it is quicker and surer in starting, and installation and maintenance costs are lowered.—*Benjamin Electric Mfg. Co., Des Plaines, Ill.*

Gasoline Driven Chain Saw

A new portable, gasoline driven chain saw unit is available designed to cut a tree or pile and leave only a short stump. The saw can be swiveled to cut in any direction and is equipped with a chain saw sharpening device which can be used at the job site. The saws are available in 24 in., 36 in. and 48 in. lengths and in models powered by compressed air, electricity or gasoline. The air driven unit may be used under water.—*Mall Tool Co., 7740 So. Chicago Ave., Chicago.*



Small Compressor

The Schramm Model No. 50 a compressor just recently put into production is a small, compact unit which has mechanical intake valve, long life discharge valves and multi-cylinder construction. This new design has four cylinder "V" type construction that does not require a cooling unit or running water. It is an ideal compressor for installations where a limited amount of air is required and is suitable for pressures up to 200 psi.—*Schramm, Inc., West Chester, Pa.*

Drum Controllers

Small and compact in size, a new line of drum controllers for small cranes and hoists has special features of outstanding interest. A rope operating lever, embodying a new equalized torque prin-

Balanced EASY WHEELING

STERLING QUALITY in every detail: Sturdy steel tray, all welded (no rivets); smooth inside surface; Top edge reinforced by continuous butt-welded rod; V-shaped tray braces; Steel wheel (steel, solid rubber or pneumatic tired); Malleable iron wheel-guard; No. 1 Northern Hard Maple handles; Channel steel legs with cross and diagonal braces; Steel Leg-shoes; ball or roller bearings. See STERLING for quality!

Stocked at Warehouses and Distributors
(S-17, 4 cu. ft.—S-18, 4½ cu. ft.—S-19, 5 cu. ft.)

STERLING WHEELBARROW CO., MILWAUKEE, WIS.

Sterling S

Look for this Mark of STERLING Quality

WHEELBARROWS

Compact! Powerful! Safe!

DISTRIBUTABLE CONTROLLED POWER

with Beebe Bros. ALL STEEL HAND HOIST

SEATTLE, U.S.A.

★

Money Has Been Saved on These Jobs!

1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.

Hudson River Bridge sidewalks were laid in sections with 32—5-Ton Beebes.

Longest wooden trusses in world were installed with ONE 5-Ton Beebe after power hoists proved impractical.

★

When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 15 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

BEEBE BROS., 2720 6th Ave. S., Seattle, U.S.A.

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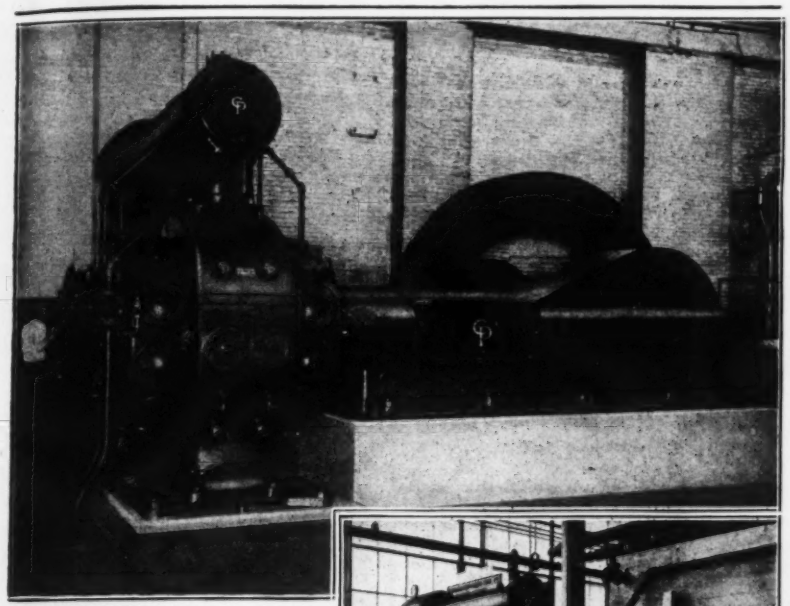
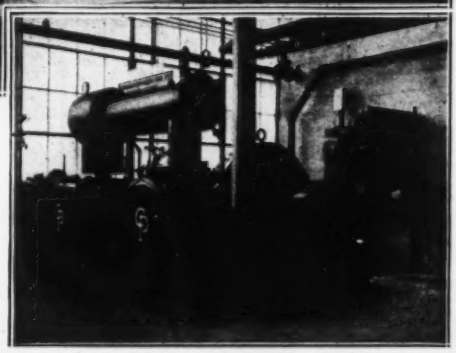
"THE STRONGEST GEARED POWER FOR ITS WEIGHT IN THE WORLD"

O-CE COMPRESSORS TO DEFENSE PLANTS





↑ WITHIN A FEW MONTHS, thirty-five Chicago Pneumatic O-CE Horizontal-Duplex Compressors were installed in well-known shipyards. This popular compressor is available in capacities of 350 to 10,000 c.f.m.

SYNCHRONOUS MOTOR-DRIVEN → O-CE Compressor, 800 c.f.m. piston displacement, in well-known aircraft plant. Simple, efficient, five-step regulation varies the output to meet load.

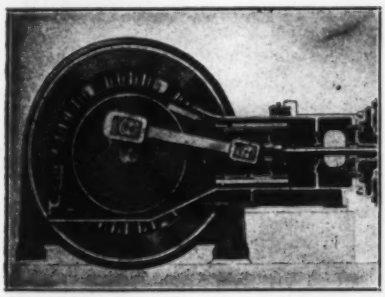
EIGHT 6,000 C.F.M. COMPRESSORS RUSHED TO EASTERN SHIPYARDS

Model Noted For Dependability

NEW YORK—Familiar equipment in new shipyards, aircraft factories and other defense plants are Chicago Pneumatic O-CE Horizontal-Duplex Compressors. Sound in design and ruggedly built, these popular compressors are ideal for continuous, heavy duty operation. The large effective area of their well-known Simplate Valves insures minimum power consumption. Their five-step regulation, low maintenance cost, outstanding reliability and other CP features make them the logical selection for plants which must have dependable, 24-hour-a-day air power.

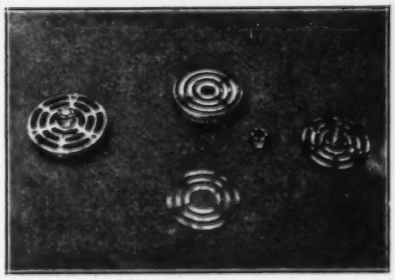
CHICAGO PNEUMATIC TOOL COMPANY

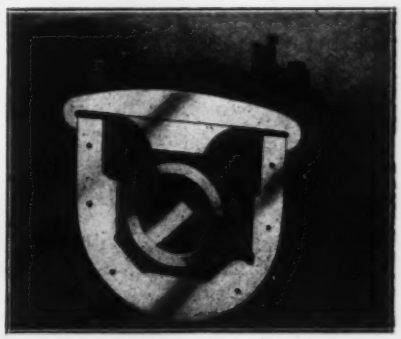
General Offices: 6 E. 44th St., New York, N. Y.



↑ CP FLOOD SYSTEM OF LUBRICATION assures maximum reliability. No pump or other working parts to fail and endanger running gear; no small oil lines to clog. This method provides all bearings with a copious supply of oil which also serves as a coolant and returns to the pump to be used again.

ACTUAL MEASUREMENTS PROVE that CP Simplate Valves, with their annular ports and straight, uniform lift, possess the greatest effective area for a given valve diameter, thus assuring lower power consumption. Straight valve lift, together with low air velocities resulting from large effective area, account for the remarkable endurance of these valves. ↓





↑ MAIN BEARINGS of two-piece design are easy to align and adjust—vertically by shims, and horizontally by wedges. Can be adjusted with the machine in operation; can be removed and replaced without lifting out the shaft.

CHICAGO PNEUMATIC

AIR COMPRESSORS

ALSO: Pneumatic Tools, Electric Tools, Rock Drills, Hydraulic Aviation Accessories, Diesel Engines

PORTABLE
STATIONARY
AIR OR GAS
MOTOR DRIVEN
STEAM DRIVEN
DIESEL ENGINE
DRIVEN

Big Savings
. . . IN HANDLING MATERIALS

A simple Sauerman Scraper installation stores and reclaims crushed stone.

Sauerman Scraper digs sludge from reservoir and hauls spoil 800 ft. to pile.

This shows a Sauerman Scraper as used for open storage of coal, ore, etc.

ON jobs where materials are to be moved distances of several hundred feet or more, a SAUERMAN Drag Scraper or Cableway has an advantage over other equipment because it is able to dig, haul and place the material in a continuous, straightline operation, doing away with the expense of rehandling.

SAUERMAN machines are designed in small capacities as well as large. There are light, portable units that can be used profitably to handle 50 to 100 tons per day and there are huge machines that will move as much as 1,000 tons per hour.

GET THIS USEFUL BOOKLET

Typical examples of pit and bank excavation, alluvial mining, moving blasted ore, deep dredging, stock-piling and reclaiming, etc., are illustrated in the Sauerman catalog. A copy of this booklet is yours for the asking.

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Get help in passing license exams from this practical book—

Here is a compact, handy manual, by two well-known engineering writers, that meets all needs for quick review of, or reference to, the most important elements of designing simple structures—of special value to those preparing for license or registration exams.

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ELEMENTARY STRUCTURAL ENGINEERING

By L. C. Urquhart and C. E. O'Rourke, Professors of Structural Engineering, Cornell University. 348 pages, illustrated, $3.00.

Use this book for quick check-up and reference on design fundamentals, procedures and calculations for simple steel, timber, and concrete members and connections. It gives you 1) helpful groundwork in the principles of structural mechanics; 2) useful thumb-nail review of materials; 3) requirements of loads for various types of structures; 4) methods of computing deflections of beams and trusses; 5) design treatment of such structural members as homogeneous beams, plate girders, reinforced concrete beams, tension and compression members in trusses, columns, members, and footings.

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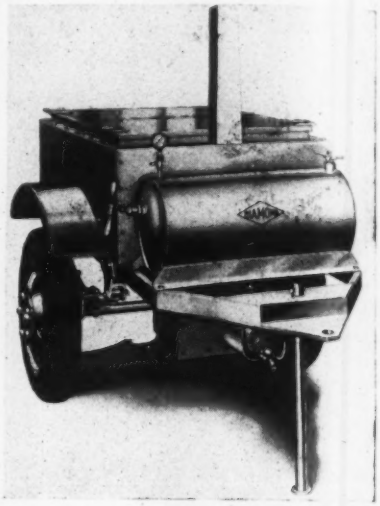
ciple, entirely eliminates the cumbersome sheave wheel, rope guard and external return spring, and provides smooth, easy operation even when the rope is pulled at an angle. A new anti-plug feature increases drum life by making it impossible to whip the drum from full forward to full reverse position. Drums can be reversed quickly, but a definite time delay is required in the off position.—*Cutler-Hammer, Inc., Milwaukee, Wis.*



Portable Tar Kettle

Diamond has a new line of portable tar kettles in five capacities from 75 to 315 gallons. The unit has a Mahr burner which is highly efficient and lights quickly. The heat envelopes the entire kettle making two complete passes before going up the stack. Unmelted material is kept separate from the hot material by a heavy steel screen so that new material may be added at any time. The Diamond kettle is all steel and all joints are electric welded. The frame is also steel and mounted on pneumatic tired wheels for rapid portability.—*Diamond Iron Works, Inc., Minneapolis, Minn.*

Swimming Pool Paint

A real rubber paint, including rubber base, is now available designed particularly as an alkali-proof swimming pool paint. It is said to be possible to paint outdoor concrete swimming pools with a white or tinted coating using Paratex rubber base paint. This material is said to have decided germicidal qualities which would be a further advantage for use on swimming pools.—*The Truscon Laboratories, Caniff & G.T.R.R., Detroit, Mich.*

Cold Process Cleaning

Announcement is made of a new mineral grease and dirt digestive solvent called Gunk X-11, available in the form

1942's Highways . . . ???

- **What Will They Be Like?**
- **How Many Will Be Built?**
- **How Will They Be Affected By The War?**

These questions will be discussed and analyzed in Engineering News-Record's Annual Highway Number . . . to be published Feb. 12th.

Solutions of these vital highway problems will determine the locations of many jobs, the allocation of materials and equipment.

The authoritative and timely treatment of these problems in this issue will be a practical aid in planning for the coming 12 months.

Here's a preview of the articles scheduled:

Survey by States

In a comprehensive study of the various states, highway engineers tell how each will meet the highway problems created by the war.

This roundup will give the highway industry valuable information with which to demonstrate that cessation of highway building would be a serious handicap to our war effort.

Concrete and Bituminous

Current practices in the design and construction of concrete pavements will be the subject of a major article. The author is a Portland Cement Association engineer. He will indicate the significant trends and tell how shortages of such materials as reinforcing steel are influencing today's highway designs.

Bituminous pavements will get similar treatment in an article by an Asphalt Institute engineer.

Soil Stabilization

This important subject will be covered in two articles: one by engineers of the Public Roads Administration, the other by a state highway department engineer.

Timber Bridge Construction

Because of the steel shortage, highway engineers are examining the extent to which wood can be used for bridges. An engineer who has made a special study of this subject will offer his findings in a comprehensive report.

Divided Highway Design

Up-to-date information on divided highway design is lacking. To meet this need the editors of Engineering News-Record have gathered material from all state highway departments engaged in this type of work. The response indicates the wide interest in this subject.

Vital Statistics

As in previous years, this issue will show mileages of various types of highways built in 1941, expenditures during that year and anticipated expenditures for 1942.

Thus, here is an issue you won't want to miss. For it will be packed with timely and authoritative information . . . helpful and vital data . . . for men engaged in other types of civil engineering and construction as well as highway building and design.

So, if you plan to change your address, inform us immediately to insure that your copy reaches you promptly. Write to:

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Fast Material Handling with

NOVO HOISTS

JUST to show you what can be done with a given size, Novo hoist, here is a Double Drum Model DH Hoist powered with a 40 H. P. engine. The front drum operates a material elevator the rear handles an 18½ Cu. Ft., concrete bucket. And here's what it does in one day.—Places 4374 Cu. Ft. of concrete and takes up the brick mortar and material to keep 14 brick layers busy on the fifth floor.

Here are the very obvious reasons why such performance is obtained:

Easy control with Novo screw thrust which puts a tremendous leverage behind the shifter rod.

Smooth, fast, safe action with Novo double cone friction blocks. They take hold of both sides of the friction groove—twice the effective friction area.

Self-energizing brakes. The drop of the load helps set the brakes resulting in easy handling.

Roller chain drive gives efficient, quiet transmission of power.

A complete line of Builders' and Dragline Hoists—Gasoline, Electric and Diesel.

FREE HOISTING DATA

We have installation Data Sheets that give valuable operating facts on various types of hoisting jobs. Send for free copies.

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Send me literature on Novo Hoists .....size ..... Also send Novo Hoisting Data Sheets.....
OTHER NOVO EQUIPMENT—Pumps ..... Light Plants ..... Power Units.....
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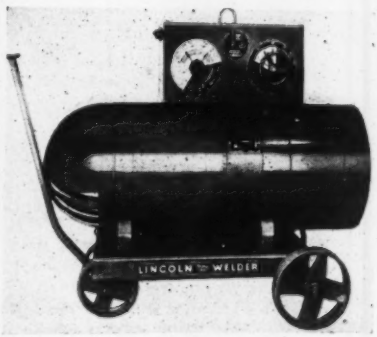
City .....

of a concentrate which may be diluted before use to charge large open cleaning tanks or vats. It is stated that the newly developed digestive solvent tank is a superior substitute for Trichlorethylene vapor phase metal cleaning tanks, particularly in heavy duty automotive and heavy equipment applications where there is much insoluble dirt or smut to be removed. The cleaning method is carried out by cold immersion of greasy or dirty parts. The new solvent not only takes the cling out of hard mineral dirt and grease accretion but emulsifies them as well so that they may be instantly and completely rinsed away by sluicing with a water hose. The removed oil and dirt disappears in the form of a milky oil-in-water emulsion which does not clog drains or present a fire hazard. Only simple rectangular tanks are required for this use.—*Curran Corp., Malden, Mass.*



Improved Welder Control

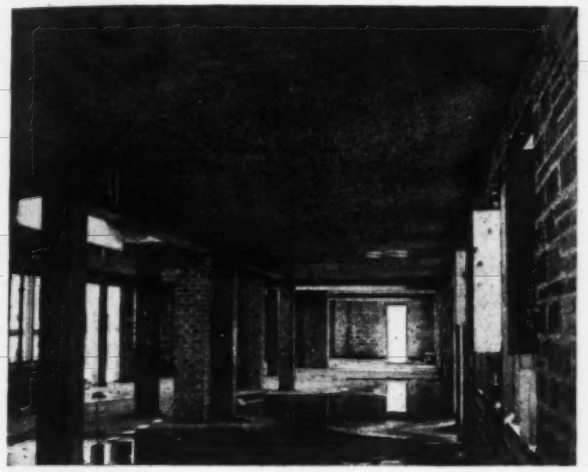
Improved and simplified design of its exclusive system of "Dual Continuous Control" for arc welding machines which eliminates the need for meters showing volts and amperes is announced by Lincoln. This line of welders has both job selector and current control calibrated and equipped with dials which indicate the type of work and the number of amperes for each setting. It is claimed that this feature enables the welding operator to secure highest quality welds and highest possible welding speeds because he can vary both the slope of the volt-ampere curve and the amount of welding current independently and positively to suit every job encountered. The new development is said to make it possible to set and read the current from the dial, eliminate trouble and expense resulting from meter breakage, and to make polarity reversal simple and visible.—*The Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio.*

Plastering Chart

A comprehensive new reference chart describes the uses and advantages of all types of interior plaster and includes a glossary of 112 plastering terms. The

Above—CHARLES ST. HOUSING, DETROIT, MICH. *Solid Slab.* Contractor, Consolidated Construction Co., Chicago, Ill. Architect, Michigan Housing Associates, Detroit, Mich.

Below—Section of finished floor—St. Bernard Housing, New Orleans, La., Genl. Contractor—Madsen Construction Co., Minneapolis, Minn., Architect—Benson, Christy & Spink, New Orleans, La.



Below—Brand Whitlock Homes, Toledo, Ohio, Genl. Contractor—J. H. Berkebile & Sons, Toledo, Ohio, Architect—Britsch & Munger, Toledo, Ohio

HAUSMAN *Speeds Up Concrete Form Setting*

Today it is imperative that we speed all construction to the earliest possible completion to provide greater facilities for all war materials. Hausman Forms speed up form setting operations—eliminate uncertainty in your concrete costs—assure minimum field expense.

Hausman will estimate and contract for your concrete form setting operations—Hausman Service guarantees a time limit on all form setting—Hausman experience in estimating form setting costs will save both time and money for the designing engineer and contractor.

HAUSMAN

FORMS FOR OTHER PURPOSES

Hausman also builds ribbed slab forms, removable steel forms for all types of construction where steel forms are economical and adjustable round column molds for multi-story buildings.

WRITE for DATA SHEET

The HAUSMAN STEEL Company
TOLEDO OHIO

DATA SHEET
gives computed volumes of concrete in various sizes of Circular Columns, Column Heads, Beams, Ribbed Slabs.

THE HAUSMAN STEEL COMPANY, Toledo, Ohio

Please mail this convenient and useful tabulation of data to save time in figuring concrete volumes.

NAME .....

COMPANY .....

ADDRESS .....

. . it's Arkwright across the board. For draftsmen know that the quality of Arkwright Tracing Cloths never varies. They know that Arkwright standards stand . . in war as well as in peace!

Smoothness of surface, permanent transparency, ability to take erasures without smudging–that's what Arkwright quality has always meant. And that's what it means today . . what it will continue to mean. What's more, delivery is as prompt, as dependable as ever.

Since there are four brands of Arkwright Tracing Cloths, one is bound to be suited to your type of work. So why not write for free samples – and new catalog? Arkwright Finishing Company, Providence, Rhode Island.

Arkwright TRACING CLOTHS

"AMERICA'S OLDEST AND FINEST"

Sold by Leading Drawing Material Dealers Everywhere

We can help solve your problems on

SLUDGE • GUM
VARNISH • RUST
and CORROSION

in all types of engines and fuel tanks

SEND FOR ENGINEERING AND SERVICE DATA

PETROLEUM SOLVENTS CORPORATION

331 MADISON AVENUE, NEW YORK, N. Y.

Manufacturers of additives for motor oils and solvents for all types of petroleum residues

chart shows at a glance what each base coat material or finishing plaster is used for; what its advantages are; whether it contains sand or must be sanded on the job; what its coverage is per ton; and what its relative cost is. Recommendations are made for the type of plaster base over which each type of base coat plaster should be used and recommends the size of grounds and thickness of plaster over lath, and tells whether a base coat plaster is fibered or unfibered.—*United States Gypsum Co., Chicago, Ill.*

Emergency Assistance

Wallace & Tiernan have announced that during the present emergency they are organized to provide special assistance, either day or night, in planning and installing emergency chlorinating equipment. Special information is now available on the W&T emergency chlorination trailer, the W&T hypochlorinator and the W&T main sterilizer, all of which are particularly applicable to emergency chlorinization. The W&T emergency chlorination trailer has been developed so that it now covers a capacity range of from 2 to 300 lb. chlorine per day. It is arranged to apply chlorine solution against negative heads to an open well or reservoir or against pressure and is particularly designed for emergency work at any point in a distribution system. Arranged for either direct gas feed or for solution feed, the W&T main sterilizer is an all purpose machine, using liquid chlorine for applications up to 300 lb. per day.—*Wallace & Tiernan Co., Inc., Newark, N. J.* (*Telephone Humboldt 3-6000.*)

Corrosion-Resisting Valves

Jenkins Bros., manufacturer of valves, announces that it has materially increased productive capacity of Corrosion-Resisting Alloy Valves. This puts the company in the position of offering faster delivery on these valves for orders having high priority ratings. The line of Globe, Angle, Y and Check Valves has been augmented by Solid Wedge and Double Disc-Taper Seat Gates in sizes to 6". Another innovation is "Certified Castings," each casting being x-rayed as well as pressure-tested. Descriptive booklet "SS" is offered.—*Jenkins Bros., 80 White Street, New York, New York.*

Water Equivalent

Sparling has available for use three convenient tables of water equivalents set up in vertical alignment. Conversion factors are given for weight, power and volume, rate of flow, and velocity in different pipes. These are the tables formerly available separately on blotters. —*R. W. Sparling, Los Angeles, Chicago, Cincinnati and New York.*

VACUUM CONCRETE PROCESS

REMOVES EXCESS WATER FROM CONCRETE SLABS FOR EARLIER TROWELING HIGHER STRENGTH & 3-DAY REUSE OF COSTLY FORM WORK

VACUUM CONCRETE HELPS BUILDERS—

(Curve shows how use of Process has increased)

Cement finishers start *minutes*—not hours —after concrete is placed

100% average gain in 3-day strength

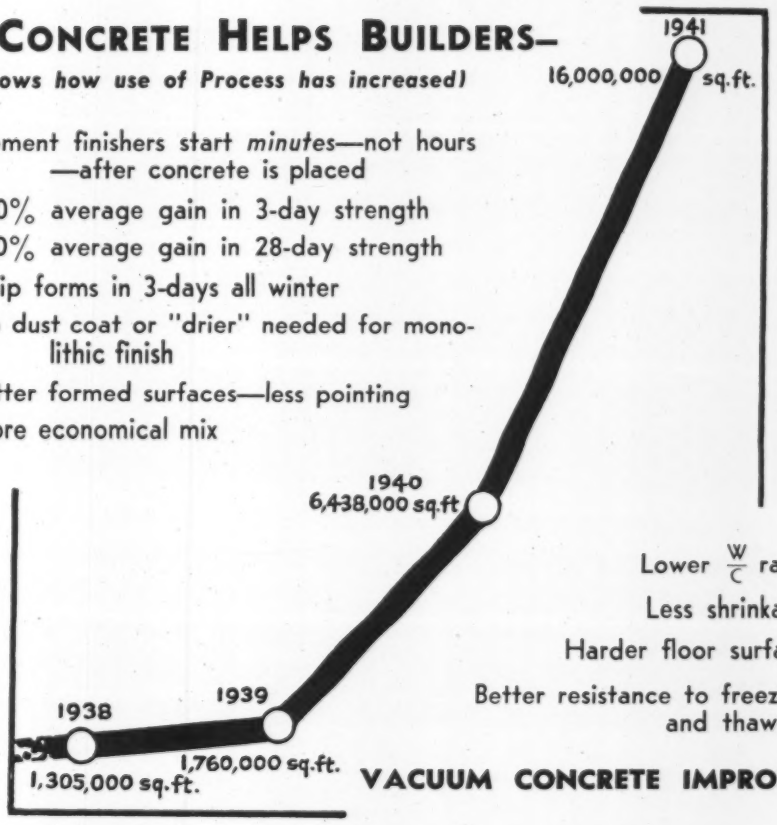
50% average gain in 28-day strength

Strip forms in 3-days all winter

No dust coat or "drier" needed for monolithic finish

Better formed surfaces—less pointing

More economical mix



Lower $\frac{W}{C}$ ratio

Less shrinkage

Harder floor surface

Better resistance to freezing and thawing

VACUUM CONCRETE IMPROVES QUALITY

In the Nation's Capital—Current VACUUM CONCRETE *Jobs:*

WAR DEPARTMENT BUILDING . . . *John McShain, Doyle and Russell and Wise Contr. Co.*

FEDERAL OFFICE BUILDING NO. 3 . . *McCloskey & Co. Contrs.*

UNION TERMINAL ADDITIONS . . . . *McCloskey & Co. Contrs.*

ENGINEER REPRODUCTION PLANT *Chas. H. Tompkins Co. Contrs.*

CENTRAL LIBRARY . . . . . *E. W. Kryz Inc. Contrs.*

Contractors - Write for Literature "C"
Engineers - Write for Literature "E"

VACUUM CONCRETE, INC.

4210 Sansom Street **Philadelphia, Pa.**

U. S. War Industries...Their Problems

Collectors Solve Water Problems

Enormous water consumption—100 gallons for every pound—is characteristic of smokeless powder manufacture. As a result, 65,000,000 gallons of water are required daily—45,000 gallons every minute at the new Indiana Ordnance Works at Charlestown, Ind., one of the largest powder plants in the world.

The problem was solved by the installation along the Ohio River of seven radial wells by the Ranney Water Collector Corporation of New York, constituting probably the largest single ground-water project in the world. Under the Ranney method, slotted screen pipes are projected horizontally into water-bearing strata from a concrete caisson. Construction is under way on two such collectors at Henderson, Ky., for the Ohio River Ordnance Works (anhydrous ammonia), and two more units are being installed for the United States Naval Powder Factory at Indian Head, Md. The method also is employed by industries and municipalities.

The horizontal screen pipes mentioned above serve as individual collecting elements of water, which flows into the concrete caisson and is then pumped to the surface by means of a deep well pump.

A brief description of the installation of a Ranney collector follows:

A reinforced concrete caisson of the open type is sunk into the ground to a predetermined depth and sealed at the bottom by a heavy reinforced concrete plug. The caisson is then unwatered, and horizontal screen lines are jacked through portholes into the water-bearing strata to distances up to 300 feet. This operation is made possible by the removal of the finer material in front of the pipe point by means of a patented boring head, the function of which is to create a hollow at the front so that the pipe can progressively be jacked with no appreciable obstruction. The fine material is washed out through an inner sand pipe inside the screen line, this smaller size pipe eventually being removed entirely.

All screen pipes are provided with control valves operated from the top of the caisson by extension stems. Inspection of the bottom of the shaft is thus made possible by closing the valves and unwatering the caisson. The last step is the installation of the pumping plant and housing. The collector is ready for service.

Among the advantages claimed for the Ranney system are low operating and maintenance costs, low first cost per unit of capacity, permanence of structure, and a low depreciation rate. The collectors are built of reinforced concrete and non-corrosive alloys. Centralized installation is also a feature and the space occupied is very small.

Water for Industry

Modern water collector system which solved a powder plant's chief problem.

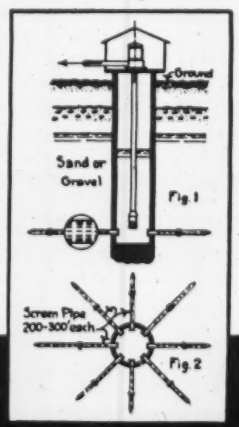
As printed in
JOURNAL OF COMMERCE
Wednesday, December 17, 1941

Do YOU need water?

The Ranney Method of Water Collection is the only complete, self-contained, centralized system for producing large quantities of water with the following advantages:

1. Centralized installation.
2. Low cost per unit of capacity.
3. Low operating and maintenance cost.
4. Elimination of water treatment.
5. Cold water the year-round.
6. Low velocities through slots, whereby incrustation of screen pipes is eliminated.
7. Permanence of structure.

Let us show you how the Ranney System has solved industrial and municipal water problems in many sections of the country.



Write today for our descriptive pamphlet.

Ranney WATER COLLECTOR CORPORATION OF NEW YORK
72 WALL STREET · NEW YORK, N. Y.

NEW PUBLICATIONS

Air Raid Shelters—Armco has just released a booklet of large drawings showing air raid shelters and munition storage magazines. Several designs are presented of shelters intended for the protection of civilians, airbase gun crews and troops. The details show them amply strong, yet light in weight, easy to erect, economical, portable and of a high salvage value. One structure shown is an air raid shelter which can be used as a pedestrian underpass to reduce traffic as well as war casualties. Also available is a small pamphlet "Five Minutes in An Air Raid Shelter" giving generalities on raid shelters.—*Armco Drainage Products Association, Middletown, Ohio.*

Finegrader—A bulletin describes the Buckeye R-B power Finegrader for road and airport runway construction. New design features are discussed including the tandem form wheels, hydraulic lifts, heavier frames, etc. Specifications are given on Model RB24F adjustable from 20 to 25 ft. widths and Model RB13F adjustable from 10 to 13 ft. widths.—*Buckeye Traction Ditcher Co., Findlay, Ohio.*

Clarifiers—"Quiescent Clarification" is the title of a new 12-page booklet. It defines quiescent clarification as the condition existing when an ideal combination of the design factors which influence proper settling in a sludge removal mechanism is obtained. Featured are the new type of scum remover and the peripheral drive mechanism for larger clarifiers.—*International Filter Co., 325 W. 25th Place, Chicago.*

Defense—The Baldwin Group in Production for Defense is the title of an elaborate brochure which describes the work of the several component parts of the Baldwin Locomotive organization for defense. It illustrates and describes the military tanks, guns, shell forgings, armor plate, projectiles and other materials which are being supplied for defense.—*The Baldwin Group, Philadelphia, Pa.*

Water Safety—A folder describes how W&T is currently in action in the cause of safer water supplies.—*Wallace & Tiernan Co., Inc., Newark, N. J.*

Law—A two volume war law service is designed to swiftly report and organize for easy reference the laws, regulations, rulings, forms and orders from every corner of the fast moving field of government regulations. Government contracts, contract forms, priorities and allocations, and war emergency regulations are covered in a loose-leaf law sys-

CONCRETE BINS AND TANKS

Will Solve the Emergency

By Conserving

CRITICAL WAR MATERIALS

★

MAN POWER

★

SPACE

★

TIME OF BUILDING

CLIENTS

Aluminum Company of America
Arguls Oil Corporation, N. Y.
Ballantine Brewery, New York
British Munition Company
Canadian Cotton, Ltd.
Canadian Industrial Alcohol Co.
Canadian National Railway
Century Cement Company, Kingston
City of Kansas City, Kansas
City of Memphis, Tenn.
Colgate Palmolive Peet
Consolidated Edison Company, N. Y. C.
D. L. & W. Coal Company, N. Y. C.
Dominion Glass Company, Toronto
Dominion Sheet Metal, Ltd.
DuPont Company, Wilmington
Erie Railroad Company
Freeport Sulphur Company
General Analine Company
General Foods Corporation
Great Lakes Carbon Corporation
H. J. Heinz, Pittsburgh
Household Fuel Company, Hartford
International Harvester Co.
Jersey Central Power & Light Co.
Lancaster Cotton Co., S. C.
Leaside Munitions Company
Lehigh Portland Cement Co.
Lehigh Valley Railway
Libbey-Owens-Ford Glass Co.
Linde Air Products Company
Lone Star Cement Corporation
Montreal Cottons, Ltd.
National Gypsum Company
New York Central Railway, N. Y.
N. Y. & Queens Elec. Light & Power Co.
North American Cement Company
Pennsylvania Railway Company
Pittsburgh Corning Corporation
Pittsburgh Coke & Iron Company
Plibrico Company, Chicago
Reading Railway
Semet Solvay Company, Buffalo
Southern Railway, Atlanta
Stone & Webster Corporation
Tattersall Company, Trenton
United States Army
United States Navy
United States Dept. of the Interior
Universal Atlas Cement Company
Vermont Asbestos Corporation
Westinghouse Company, Pittsburgh

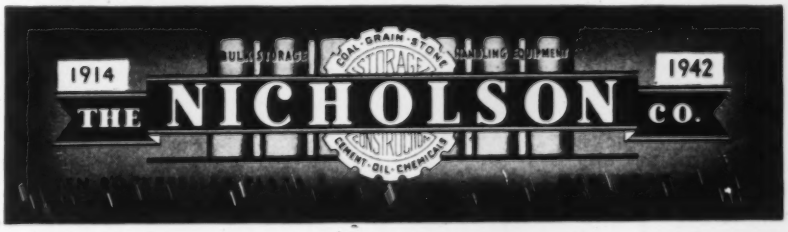
NICHOLSON concrete bins and tanks are designed and built for practically every granular and liquid material. Being built of concrete, they conserve the critically-needed steel plate.

Nicholson concrete bins are designed to require a minimum of industrial space and the carefully-designed mechanical equipment conserves the use of man power.

Time of building, so important in these emergency days, can be cut to a minimum by the use of already-created engineering designs.

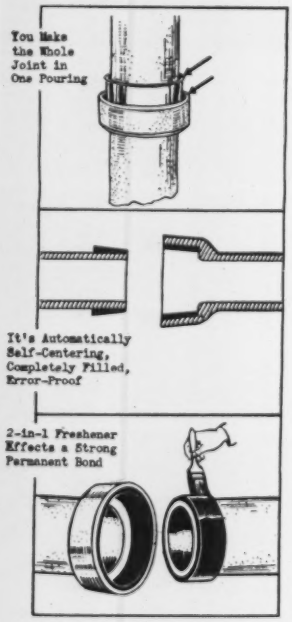
During the past twenty-eight years many of the nation's leading industrial firms, representing twenty-six varied industries, have delegated the design, construction and mechanical equipment of 6,000 concrete storage bins to this company.

For *your* "all-out" emergency effort, let the vast technical knowledge, experience and highly specialized facilities of the Nicholson organization assist in your program.



Faster — Better — Lower Cost

SEWER PIPE JOINTS
WITH
SERVICISED
2-in-1 Die Cast Method


You Make the Whole Joint in One Pouring
It's Automatically Self-Centering, Completely Filled, Error-Proof
2-in-1 Freshener Effects a Strong Permanent Bond

SERVICISED 2-in-1 Die Cast Method gives you better sewer pipe joints because you make the whole joint (both sides) with one die at one pouring.

You are sure that your joints are completely filled because both sections of the joint are matched and are thus automatically self-centering.

This method is more economical than ordinary methods because labor is reduced at the time of making the joint and matching it in the trenches. Maintenance cost is low as a result of using this procedure because the joints are 100% filled and the perfect bond that is effected by this material between each pipe is durable, flexible, and root-repellent.

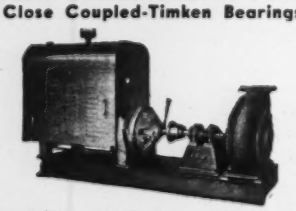
Specify the 2-in-1 Die Cast Method on your next project and obtain the maximum good will from the owner and contractor.

Any information you may desire will gladly be sent to you upon request.

Other SERVICISED Sewer Pipe Joint Compounds available to you are TUFFLEX — PREMOULDED SEWER PIPE BELT — HOT-POURED COMPOUND.

SERVICISED PRODUCTS CORPORATION
6055 W. 65th STREET — CHICAGO, ILLINOIS

ERIE
ENGINE DRIVEN DREDGE PUMPS
Close Coupled-Timken Bearings



Especially suited to small Dredges with 4" -6" or 8" Pumps
Write for New Bulletin No. 45
ERIE PUMP & ENGINE WORKS
152 Glenwood Ave., Medina, N. Y.

"GUNITE"

can reduce your construction costs. It is efficient and dependable, an established product.
WE RECOMMEND "GUNITE" for structural steel protection, floor and roof slabs, thin exterior walls, partitions, tanks, reservoirs, restoring disintegrated concrete surfaces, repairing reinforced concrete, etc. Let us suggest how "Gunite" can best solve your problems.

PRESSURE CONCRETE CO.
"GUNITE" CONTRACTORS
6 Avenue B — Newark, N. J.

tem kept always up to date.—*Commerce Clearing House, Inc., 214 N. Michigan Ave., Chicago.*

Fluorescent Lighting—A new 30-page booklet "Facts, Questions and Answers on Fluorescent Lighting" has been prepared for non-technical readers and answers popular questions in regard to cost, efficiency and maintenance of fluorescent lighting. — *Westinghouse Lamp Division, Bloomfield, N. J.*

Tournapass—A bulletin describes the purpose and use of the Tournapass, a new method to relieve cross street congestion by installation of an all steel, all welded grade separation device which fits into the traffic lane. It is portable, demountable, easily handed to the site; set up and readily moved to another location as traffic conditions vary.—*Le-Tourneau Co. of Georgia, Tournapull, Georgia.*

Galion in National Defense—A booklet describes the part of the Galion Co. in supplying equipment for national defense.—*Galion Iron Works & Mfg. Co., Galion, Ohio.*

Form Devices—A folder describes the several form tying devices, special cones and rod clamps which are available for a wide variety of concrete form work. The Colt cone-coupler and Colt form rod clamp for application to cantilever forms are featured.—*Samuel S. Colt, 113 No. Center St., Orange, N. J.*

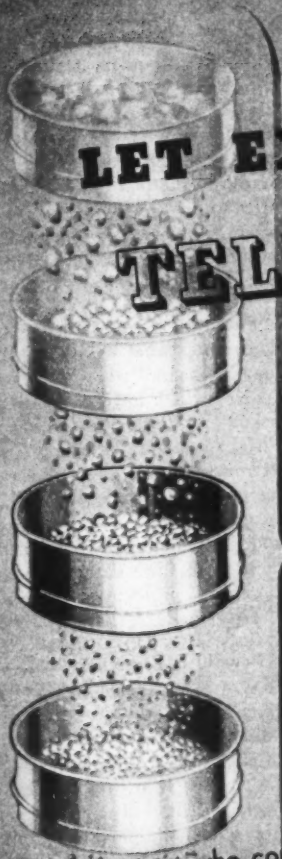
Water Conditioning—A new catalog describes "Supplementary Treatment of Boiler Feedwater" in which is presented a complete discussion of the various ways in which a plant might feed chemicals to further condition the water after external water treatment.—*The Permutit Co., 330 West 42nd St., New York City.*

Plant Gates—A new folder describes Perey plant gate control installations to control entrance and exit of workers at industrial plants, shipyards, military and naval areas and to simplify the problem of gate inspection identification.—*Perey Turnstile Co., 101 Park Ave., New York.*

Refractories Handbook—A pocket-size 72-page handbook gives useful tables on actual use of various types of brick and other information essential to refractory users. The various shapes of material regularly available are described.—*General Refractories Co., Philadelphia, Pa.*

Rubber Putty—Plastikon rubber putty, a non-hardening, corrosion resistant, waterproof and airtight material which requires no mixing and which has

LET EXTRACTION TESTS TELL THE STORY



ACCURATE GRADATION

ACCURATE PROPORTIONING

THOROUGH MIXING

CONSISTENT PERFORMANCE

SIMPLE INSPECTION

Many who completely understand the fundamental principles of the Barber-Greene Mixer logically wonder if it is possible for the results to be as good as the theory. They know that the aggregate feeder is calibrated by weight, on the job; that each size of aggregate is continuously, but separately fed into the pugmill. They know that the bitumen metering pump and the aggregate feeder are mechanically interlocked to deliver a constant ratio, and that the materials are fed in a small continuous stream, giving a practically uniform distribution at the start of the mixing. But with such revolutionary advantages they want to see the final proof. Job after job has produced this proof. Laboratory analyses of samples from the discharge of the pugmill, and core samples from the finished course prove the highest accuracy of proportioning, the finest homogeneity.

You owe yourself a complete understanding of the principles and *results* of what is truly TOMORROW'S MIXER TODAY. Write for literature, there is no obligation. Barber-Greene Company, Aurora, Illinois.

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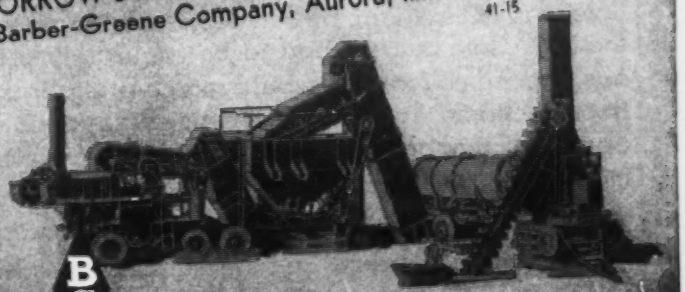

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BARBER GREENE

"Better than promised"
-35 to 38 HOLES PER HOUR with BUDA EARTH DRILL

. . . . says Contractor on
DEFENSE HOUSING PROJECT

R. W. KUHNE, of Kuhne-Simmons Construction Co., says further: "We expected to drill 18 to 25 holes per hour, and actually put down *35 to 38* holes per hour (approx. 300 holes per day) with the Buda Earth Drill . . . even with an inexperienced operator, we were getting the expected performance by the end of the first day."

This job required a total of 4,018 foundation holes to be drilled at two defense housing projects. Each hole was 18" in diam. by 3 ft. deep, used for pre-cast footing. Hole centers had to be accurately drilled and spaced so footings would match pre-fabricated floor sections. It would have been impossible to approach this accuracy and speed by using hand methods.

Have you a defense construction problem? Then get further facts about Buda Earth Drills now!

THE BUDA CO. HARVEY (Chicago Suburb) ILLINOIS

quick drying and excellent adhesion, is described in a catalog sheet.—*B. F. Goodrich Co., Akron, Ohio.*

Tractors—"Diesels on Defense" is the title of a 24-page booklet which illustrates the enormous part Caterpillar is playing in our own national defense and for the friends of America during the present war. Ask for Form 7016. "They Wrote A Letter!" is a 12-page booklet filled with copies of letters from contractors concerning operation of Caterpillar diesels. Request Form 6913.—*Caterpillar Tractor Co., Peoria, Ill.*

Patents—A real handbook on patent law is presented in "Patent Background for Engineers" which is a collection of articles which have previously been published in the Allis-Chalmers Review. Pitfalls, patent fallacies, protection of new inventions, interference and other major items are discussed by authorities on the subject. The trend in patent law and compulsory patent licensing are featured with information on new developments in prosecution on infringement. —*Allis-Chalmers Mfg. Co., Milwaukee.*

Portable Electric Tools—The 1942 line of Thor portable electric tools is described in an attractive new 64-page catalog, No. 37, which gives complete descriptions, specifications and prices on the entire Thor line of universal type electric drills, saws, hammers, grinders and other equipment. Printed in two colors and profusely illustrated with photographs of tools in operation, the book is a helpful guide in the selection of proper equipment for different applications. Featured in the catalog are the Thor ¼ in. and ½ in. capacity drills and the new "Thor-Nado" electric hammer and the Thor Nibbler for cutting metal. —*Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.*

Protective Coatings—A 15-page catalog describes the Tocol line of protective coatings. Featuring the suggestion that industry may have to "wear its old clothes longer," the catalog suggests the proper type of coatings for various uses for preservation.—*Protective Coatings, Inc., 10391 No. Lawn, Detroit, Mich.*

Water Softening—Zeolite Water Softening is the title of a new bulletin, No. 112, which answers the question of the type softener best adapted to particular installations.—*American Water Softening Co., Lehigh Ave. and 4th St., Philadelphia, Pa.*

Road Maintenance—Road Maintenance Equipment is the title of an illustrated broadside which describes the many types of road maintenance equipment in the Littleford line.—*Littleford Bros., Cincinnati, Ohio.*

LEADITE

The Pioneer Self-Caulking Jointing Material for Bell and Spigot Water Pipe

Products

LEADITE and the following tools and equipment for use with LEADITE:

BRAIDED JUTE, JOINT RUNNERS, GASOLINE and WOOD BURNING MELTING FURNACES, POURING LADLES, POURING POTS, YARNING IRONS and METAL POURING GATES.

Description

Leadite is principally used for making joints in cast iron bell and spigot water mains; is shipped in powder form in sacks containing 100 pounds.

Users

Water works superintendents, engineers, contractors, mines, railroads and industrial plants all over the world use Leadite. Thousands of miles of pipe jointed with Leadite are in service.

Method of Use

The joint space is first "yarned" and the Leadite is melted and poured into the joint, but requires no caulking. Leadite melts at approximately 250° F. Lead melts at approximately 620° F.

Comparative Quantities

One hundred pounds of Leadite are equivalent to approximately four hundred pounds of pig lead based on the joints being made the same depth with either material. It will be easy to figure the approximate quantity of Leadite required for any given quantity of pipe by referring to our Reference Table, copy of which we shall gladly send to you upon request.

Comparative Cost

Under normal conditions, the economies effected by the use of Leadite save approximately 50% to 75% over the method which requires caulking, owing to the saving effected in material and labor.

Saving

Because Leadite saves on the items of caulking charges, digging of large bell-holes and reduces cost of trench pumping to a minimum, Leadite eliminates most every superfluous operation in jointing cast iron water mains, thus permitting the work to be completed with the least amount of effort.

Tools

As no caulking is required, fewer tools are needed.

No Caulking

Leadite joints require no caulking because Leadite adheres to the pipe from the yarn or jute out to face of bell, making a watertight bond. However, a Leadite joint may be melted or cut out at any time if desired in making connections, etc.

Durability

Leadite has been tested and used for more than 40 years and experience has proven that Leadite joints improve with age.

Expansion and Vibration

Leadite is used with excellent results under railroad tracks, highways and over and under bridges where severe vibration has demonstrated the value of using Leadite on this class of work.

Utility

Leadite is very easy to handle. It is used on all sizes of pipe from four to eighty-four inches in diameter and under all conditions and pressures encountered in water works construction.

Electrolysis

Leadite resists electrolysis.

Damage Suits

Claims for damages caused by joints blowing out are reduced because Leadite joints, if properly made, will not blow out under any pressure common in water works construction.

Transportation

Considerable freight charges are saved because Leadite is light in weight. This also means a saving in cartage and handling on the work because you move approximately one-fourth the weight of jointing material.

Delivery

We make prompt shipments of Leadite in any quantities from stock.

Fuel

Saves fuel because you melt approximately one pound of material instead of four, and less heat is required to melt Leadite than is needed to melt lead.

Be sure it is Leadite and not something "Just as Good"

THE LEADITE COMPANY

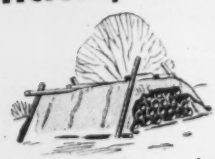
Girard Trust Company Bldg., Philadelphia, Pa.

No Caulking

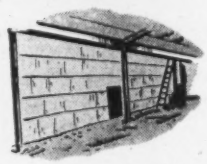
KEEP JOBS MOVING
In Spite of the Weather

This winter — there can be no delays in vital defense construction. Work must go forward at top speed, regardless of cold, rain, snow or wind. PROTECTION will play a big part in getting jobs done.

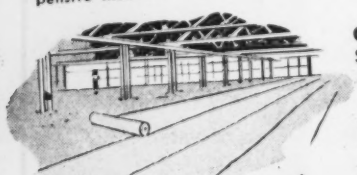
SISALKRAFT Gives Efficient, Low-Cost PROTECTION



COVERING tools, equipment and materials on the job—Effective SISALKRAFT covers are more waterproof, yet much less expensive than canvas.



CLOSING IN for winter work and steam curing . . . building temporary weather-tight barriers.



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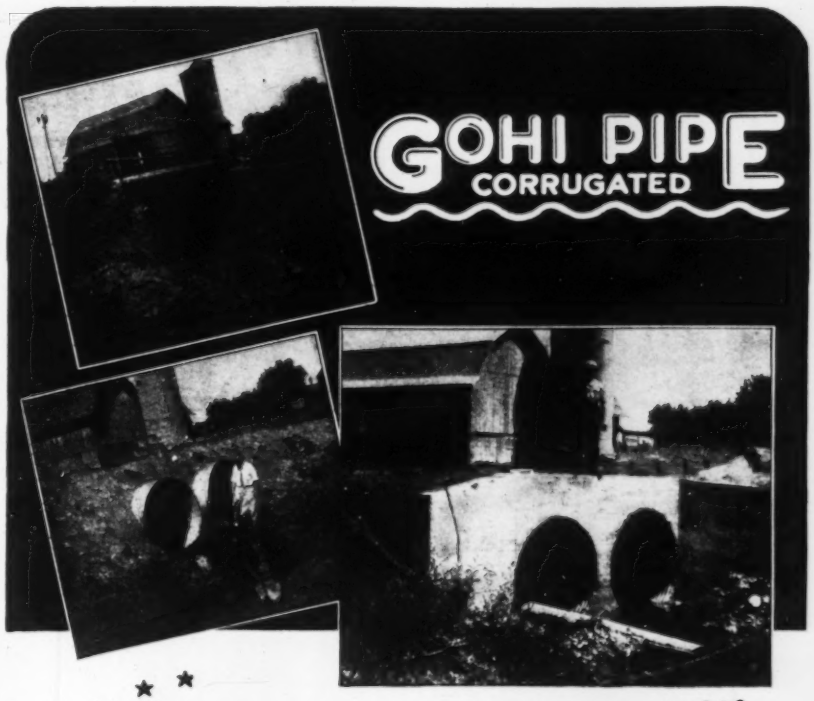

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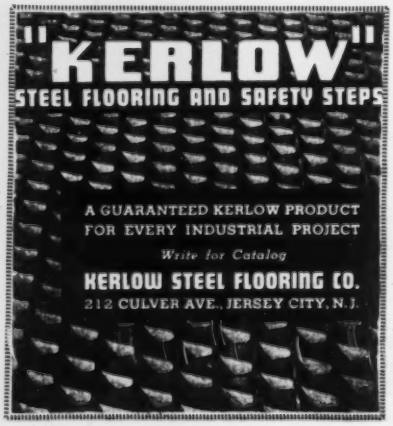

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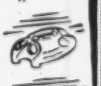

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JANUARY 22, 1942 • VOLUME 128 • NUMBER 4

FWA will pool personnel to expedite housing program

Baird Snyder, deputy to the administrator, is made responsible for housing jobs, which will be handled as FWA staff assignments instead of as USHA or PBA projects

Final Congressional action on amendments to the Lanham Defense Housing Act leaves the Federal Works Administrator a free hand in allocating housing projects among his various agencies. And reorganization of the setup for building permanent defense houses is now in full swing. Organization of the demountable house program got underway a week ago (*ENR*, Jan. 15, p. 75).

FWA Administrator Fleming has turned over the immediate responsibility for the housing and defense public works programs to his deputy, Baird Snyder. Snyder is a graduate engineer, practiced engineering and later was a construction contractor until he joined the government service as associate and then chief engineer in the Farm Security Administration. Just before coming to FWA he was deputy to Fleming in the Wage-Hour Administration.

Snyder wants to treat the housing program as a Federal Works Agency job rather than a USHA job or PBA job. He wants to get away from the idea that the various agencies in FWA are entitled to certain housing jobs by rights.

Technical personnel from FWA.

To accomplish this objective, the FWA agencies are to be treated—for defense housing purposes—simply as a pool of technical personnel. When a housing job in a particular community comes along it will not be assigned to an agency. It will be assigned to a man, perhaps in PBA, perhaps in a USHA regional office, or perhaps on the FWA staff. He will have to get together a staff, mostly but not necessarily, from the people he's been working with right along. In some cases, a single project might cut across agency lines—involving a site planner from USHA, a designer from PBA, a lawyer from FWA, or the like.

And when a job is thus turned over, by memorandum, to a particular individual, he will be responsible as regards that job to Snyder rather than to the commissioner of public buildings or the USHA administrator.

Defense public works is not to be merged with the housing job. But wherever, in any community, close coordination is needed between the housing job and provision of utilities or schools, a DPW man will be assigned to work with the man handling the housing job.

Although access roads frequently are required in the same areas that need housing and public works, no close connection is seen between the jobs, and Public Roads Administration procedure will not be affected by the current reorganization.

An incidental advantage of this loose set-up is that it will not interfere with an overall reorganization of government housing that the President may put into effect. Some months ago, the President commissioned Judge Rosenman, his adviser on government reorganization, to study the whole housing picture. Rosenman is still working on the matter, is understood to have in mind the creation of a single agency to handle all permanent war housing and which could become a public housing agency after the war.

Considerable simplification of the engineering and architectural phase of the housing program is intended. FWA technicians are now reviewing all the house designs that have been used in the program to date and will select from them some thirty or forty standard designs to which future projects will be restricted.

Design work at the site—grading, utilities, placement of houses and choice of house designs—will be done by outside architects and engineers retained for the purpose. On each project an architect-engineer team will be retained and will be responsible for inspection of construction as well as for design. They will have very full authority over the job, except that a government man will sign the actual estimates.

It is intended to decentralize as much as possible the retainer of engineers and the employment of contractors. The machinery is not yet fully set up, but probably the men in the field will be given full authority to sign contracts. Most construction contracts will be awarded by negotiation, since it is felt that under present conditions competitive firm price contracts are likely to be too high.

• • •

Billion and a half asked for war construction

The President's request to Congress this week for $28,500,000,000 of new war money includes something like a billion and a half for construction. Largest and most uncertain amount consists of part of the $933,000,000 asked for expansion of armament production facilities. Much of this money will be used for machinery but some will unquestionably go for construction of new factory buildings.

For Naval public works, $331,000,000 is asked, including $25,000,000 for a program of ammunition storage and $6,333,000 for a flight test center at Cedar Point, Md. Also asked is $250,000,000 for new ship repair facilities.

No request is included for money to carry out the new cantonment program or other expenses arising from the pending increase in the size of the Army.

• • •

Douglas Dam opposition now eliminated

The President has asked Congress to give TVA $30,000,000 for an immediate start on construction of Douglas Dam on the French Broad River. This project, which has been urged by OPM as the quickest way to provide power for war needs, has been before Congress previously but was defeated as a result of the opposition of Senator McKellar of Tennessee. The Senator, it is understood, has now withdrawn his opposition to the project.

When it rejected Douglas, Congress approved two other projects—the Watauga and South Holston Dams—instead, the work on these is now underway.

KEEP JOBS MOVING
In Spite of the Weather

This winter — there can be no delays in vital defense construction. Work must go forward at top speed, regardless of cold, rain, snow or wind. PROTECTION will play a big part in getting jobs done.

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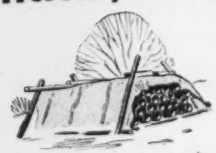

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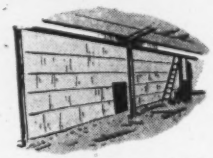

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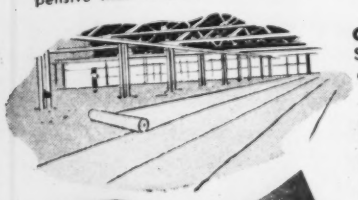

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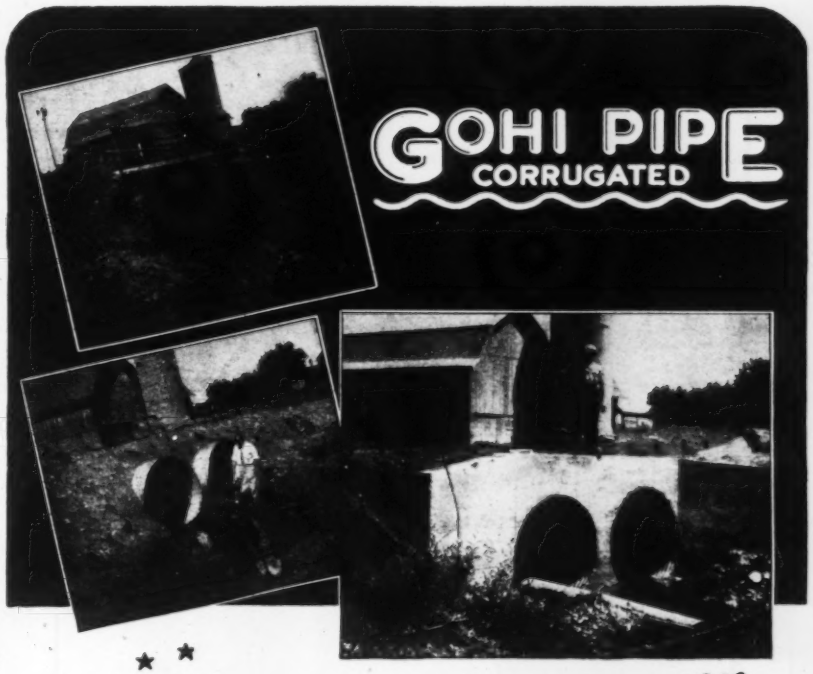

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